Tyndall°Centre
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The contribution of energy service contracting to a low carbon economy

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This is the final report from Tyndall research project *T3.21- Delivering a low carbon future*: *The contribution of energy service contracting to a low carbon economy*. The following researchers worked on this project:

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Section 1 Overview of Project and Outcomes

Abstract

Energy service contracting can provide a cost-effective route to overcoming barriers to energy efficiency. Energy service contracts allow the client to reduce operating costs, transfer risk and concentrate attention on core activities. However, the energy services model may only be appropriate for a subset of energy services and energy using organisations. A challenge for both business strategy and public policy is to identify those situations in which energy service contracting is most likely to be appropriate and the conditions under which it is most likely to succeed.

Energy service contracting is a form of outsourcing. It will only be chosen where the expected reduction in the *production cost* of supplying energy services can more than offset the *transaction cost* of negotiating and managing the relationship with the energy service provider. Production costs will be determined by a combination of the physical characteristics of the energy system and the technical efficiency of the relevant organisational arrangements, including economies of scale and specialisation. Transaction costs, in turn, will be determined by the specificity of the assets required to provide the energy services, the difficulty in specifying and monitoring contractual terms and conditions, the competitiveness of the energy services market and the relevant legal, financial and regulatory rules.

This project develops these ideas into a general framework that may be used to assess the feasibility of energy service contracting in different circumstances. The framework leads to a number of hypotheses that are suitable for empirical test. The project also proposes a definition of energy service contracting, classifies the different approaches, examines how these affect incentives and risks, provides an overview of the market in the US and Europe and examines the nature and structure of the UK market in more detail.

Keywords

Energy services; ESCOs; performance contracting; outsourcing; transaction cost economics.

Objectives

The objectives of this project were:

- To define energy service contracting, clarify how it differs from related activities, classify the different approaches and examine how these affect the incentives and risks faced by the contractor and the client.
- To provide an overview of the market for energy service contracting in the US and Europe and identify the differences and similarities.
- To map the size, scope and nature of the energy services market in the UK and identify who is providing what to whom and on what terms.
- To assess the role of transaction costs in determining the viability of different types of energy service contract in different circumstances.
- To develop a theoretical model of energy service contracting to explain a client's choice of energy services to outsource and the conditions under which an energy service contract is likely to be successful.

- To identify the economic and policy barriers to the expansion of energy service contracting in the UK and suggest measures that could be taken to overcome these barriers.

Work undertaken

This small-scale project was conducted solely by Steve Sorrell at SPRU. There were four elements.

- *Literature Review:* A comprehensive review was conducted of the academic, business and policy literature on: a) the energy services market in the US and Europe; b) transaction cost economics (TCE) and related concepts; and c) the application of TCE to outsourcing - including empirical studies of IT outsourcing. While the literature on energy service contracting provided some valuable insights into costs, risks, contractual forms, financing and other relevant issues, it was biased towards the US and generally lacked a formal theoretical framework. In contrast, the literature on IT outsourcing included a wealth of theoretical models, detailed case studies and large-scale surveys incorporating statistical tests of hypotheses. A major objective of the project was to apply the insights from these studies to the topic of energy service contracting.
- *Interviews*: The main energy service companies (ESCOs) operating in the UK were identified and their web sites and promotional materials used to identify the size, scope and nature of their activities. A total of 10 semi-structured interview were conducted with representatives of these companies, examining issues such as market size and trends, contract types, transaction costs, risk perceptions, barriers to contracting, potential policy initiatives; and the medium to long term potential for the energy services market. Three additional interviews were conducted with market specialists. This empirical work was conducted in collaboration with the Energy Systems Trade Association.
- *Theoretical model:* The results of the above were used to develop a theoretical model of the contracting decision, using concepts from TCE. This sought to explain the decision to outsource a particular energy service and the relative success of a contract. The assumption was that a client will only outsource energy services when the expected reduction in the production cost of supplying those services can more than offset the expected transaction cost of negotiating and managing the relationship with the energy service contractor. This framework led to a number of hypotheses that were suitable for empirical test.
- *Postal survey:* A postal survey was developed for clients of ESCOs in the UK, with the joint aim of mapping the size and scope of the UK market and testing the theoretical model. The constructs were based upon those used in comparable studies of IT outsourcing. The survey was distributed anonymously to clients with the help of the ESCOs themselves. Unfortunately, several ESCOs chose not to participate in the survey, leading to a sample population that was both small and biased. The response rate from participants was also low, which meant that the sample size was insufficient to derive statistically significant results.

Key findings

This study has highlighted the definitional confusion surrounding the energy services market, the misleading nature of some of the terms used and the need for a commonly agreed terminology. It has proposed a definition of energy service contracting and showed how the various types of contract can be classified by their scope (number of services included), depth (number of organisational activities included) and the method of finance. Contracts may be ‘shallow’ with a relatively ‘narrow’ scope, or ‘deep’ with a relatively ‘wide’ scope, and there should not be a presumption that a ‘wider’ or ‘deeper’ contract is to be preferred.

The market is distinguished by the range and complexity of the products on offer and the diversity of providers. There is no well-defined group of ‘energy service companies’ (ESCOs) that are distinct from more conventional companies in the energy market and the use of ‘energy service offerings’ to add value to energy commodity sales tends to be the exception rather than the rule. While performance contracting in the public sector dominates in the US, supply contracting in the private sector is more common in Europe. Similarly, while client financing dominates in the US (partly as a consequence of tax breaks for public sector institutions), financing in the UK includes a large contribution from ESCOs themselves. The UK market is large compared to most European countries, but there is scope for further expansion - particularly within public sector buildings.

The study developed a theoretical model of energy service contracting, based upon minimising the sum of production and transaction costs. Production costs are determined by the size and physical characteristics of the energy system, together with the technical efficiency of the relevant organisational arrangements - including economies of scale. Transaction costs, in turn, are determined by the specificity of the assets required to provide the energy services, the difficulty in specifying and monitoring contractual terms and conditions, the competitiveness of the energy services market and the relevant legal, financial and regulatory rules. The study developed these ideas into a general framework that can be used to assess the feasibility of energy service contracting in different circumstances.

The results suggest that, while energy service contracting may have an important role to play in a low carbon economy, a wholesale shift from commodity to service supply is unlikely to be feasible. Contracting is only appropriate for a subset of energy services within a subset of organisations, and is particularly unsuitable for final energy services at small sites and process-specific energy uses at large sites. Despite the attention given to comprehensive performance contracting, more limited forms of supply contracting may often be more appropriate. Contracting may be encouraged through broad-based policy measures such as carbon pricing, together with more specific initiatives such as information schemes and the introduction of an accreditation scheme. But the only dedicated initiative that is likely to have a significant impact is the reform of public procurement procedures to encourage contracting. In sum, energy service contracting can only form part of a broader strategy for achieving a low carbon economy.

Relevance to the Tyndall Centre research strategy and overall objectives

The project contributes to Tyndall Centre Research Theme 2 *Decarbonising Modern Societies*. While related work on energy efficiency within Theme 2 focuses upon households and transport, this project focuses on the public, commercial and industrial sectors. Energy services in the household sector are excluded because: first, there has been previous UK research on this sector over the last three years; second, the level of activity is extremely small; and third, this market is very different from the one studied.

The project should be relevant to: academics in a range of disciplines, including economics and energy policy; policymakers and practitioners in government departments and agencies; and the energy services industry itself. Dissemination to all three audiences is planned.

Potential for future work

Work is needed in five areas:

- Collection of improved data on the size and nature of the energy services market in Europe. While the European Commission Joint Research Centre has made some progress in this area, the data remains patchy and is handicapped by definitional problems and concerns over commercial confidentiality. Successful completion of the postal questionnaire developed for this study would help in this regard.
- Testing the theoretical model through a structured survey. Again, successful completion the postal questionnaire would help, although this is not the only option available.
- Refining, developing and further testing the model. At present, the model has some weaknesses including the neglect of trust in contracting relationships. Experience with IT outsourcing suggest that considerable empirical work is required to improve understanding of the contracting decision.
- Estimating the volume of energy services in the UK that is potentially ‘contractable’. This needs to combine improved understanding of the determinants of a successful contract with disaggregated data on energy consumption by end use and site size.
- Assessing the costs and benefits of targeted policy initiatives such as model contracts and standardised monitoring and verification schemes. At present, there is practically no work in this area.

Communication highlights

- Sorrell, S. (2005), ‘A framework for understanding energy service contracting’, presented at the European Council for an Energy Efficient Economy (ECEEE) 2005 Summer Study, *Energy Savings: What Works & Who Delivers?*, Mandelieu, Côte d'Azur, France 30 May-4 June 2005.
- Sorrell, S. (2005), ‘The economics of energy service contracting’, submitted to the Tyndall Working Paper series and later to be submitted to the *Energy Policy* journal.
- Sorrell, S. (2005), ‘The economics of energy service contracting’, to be presented at the British Institute of Energy Economics 2005 Academic Conference, *European Energy – Conflicts and Synergies. Economics, security, competitiveness, environment, social* issues, St. John's College, Oxford, September 22-23 2005.
- Sorrell, S. (2005), ‘The economics of energy service contracting’, to be presented at the *ESCO Europe 2005 Conference*, InterContinental Hotel Vienna, 4-5 October 2005.

Section 2 Technical Report

Acknowledgements

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Contents

1 Introduction

A common theme in contemporary discussions of sustainability is the recasting of final demand in the economy as a collection of services rather than a collection of products (Stahel, 1997). For example, consumers ultimately require mobility and cleaning rather than private cars and washing machines and there may be ways of providing such services at lower environmental cost. Business models are emerging that provide various services in an innovative and commercially viable way, while at the same time reducing overall environmental impacts. Examples include the move from individual car ownership to membership of ‘car clubs’, and the outsourcing of ‘chemical management services’ by industrial facilities (Reiskin and Whilte, 2000, ; James and Hopkinson, 2002). Many of these developments overlap with the trend towards outsourcing non-core activities in the private sector, together with the increasing use of ‘contracting-out’ and ‘public-private partnerships’ in the public sector. There is a potential synergy, therefore, between emerging business practices, changing governance structures and a promising strategy for achieving sustainability.

Energy service contracting provides the most established example of how the ‘service model’ may become a commercial reality. Energy service contracting involves the outsourcing of one or more energy-related services to a third party. In its simplest form, an energy service contract may guarantee supplies of hot water and/or electricity at reduced cost, but in a more sophisticated form the contract may guarantee particular levels of service provision, such as lighting levels, room temperatures, humidity and ‘comfort’. In its most developed form, energy service contracting allows the client to minimise the total bill for all the services that energy provides, (e.g. heating, lighting, cooling, motive power) through a single contract with an energy service provider. This contrasts with the traditional model in which energy consumers contract separately for each energy commodity (e.g. oil, gas, electricity) and for the supply and maintenance of each type of energy conversion, distribution and control equipment.

Energy service companies (ESCOs) typically offer comprehensive contracts that include energy information and control systems, energy audits, installation, operation and maintenance of equipment, competitive finance, and fuel and electricity purchasing. These contracts allow the client to reduce energy costs, transfer risk and concentrate attention on core activities. An attractive feature of such contracts is their potential to overcome many of the obstacles that users face in adopting energy efficient technologies, such as lack of information or capital (Sorrell, Schleich et al., 2004). The energy services model may provide an effective route for accelerating the diffusion of both established and innovative low carbon technologies and has the potential to develop into wider ‘carbon services’, including carbon offsetting, renewable energy purchasing and participation in emissions trading.

While energy service contracting has been endorsed for both business and environmental reasons, it has attracted relatively little academic scrutiny. Most of the existing literature is from industry and government sources and makes little reference to economic theory. The energy services model has important parallels with other forms of outsourcing and with the private financing of public sector infrastructure, but insights from studies into these topics have rarely been applied to the energy field. As a result, the determinants of the size and nature of the energy services market are poorly understood, as is its long-term potential. This makes it difficult to assess the potential contribution of energy service contracting to a low carbon economy or to assess whether a long-term transition from energy commodity to energy service supply is a realistic or a desirable goal.

This report examines the nature and operation of energy service contracts in the industrial, commercial and public sectors and assesses its longer term potential in the UK. Specifically the report:

- Defines energy service contracting, classifies the different approaches and shows how these affect the incentives and risks faced by the contractor and the client.
- Provides an overview of the market for energy service contracting in the US, Europe and the UK and identifies who is providing what to whom and on what terms.
- Develops a theoretical model that explains a client's choice of energy services to outsource and the conditions under which an energy service contract is viable.
- Identifies the economic and policy barriers to the expansion of energy service contracting in the UK and suggest measures that could be taken to overcome these barriers.

The report focuses on energy service contracting in the industrial, commercial and public sectors. This is a well-established market involving the supply of a variety of energy services under long-term contracts to relatively large clients. The rudimentary market for energy services in the household sector is not covered since the economic determinants and policy issues are rather different (Chesshire, 2000). However, attention is paid to the extension of energy service contracting to small and medium-sized organisations.

The report develops a theoretical model of energy service contracting, using ideas from Transaction Cost Economics (TCE). These ideas have been extensively and successfully applied to the outsourcing of information services and other non-core activities, but have not previously been applied to energy services. The model leads to a number of hypotheses that are suitable for empirical test through a structured survey. Such a test was attempted during the course of the project, but insufficient replies were received to obtain statistically significant results. The report discusses the design of the survey, nevertheless, since it may provide a useful basis for further research in this area.

The report is structured as follows. Section 2 explains the nature of an energy service contract, clarifies the terminology in common use and introduces a general framework for classifying the different types of contract that are currently available. Section 3 provides a overview of the energy services market in the US, Europe and the UK and shows how the UK market differs from the 'US model' that is dominant in the literature. Section 4 develops a theoretical model of energy service contracting that combines the production costs of supplying energy services with the transaction costs of negotiating and managing the relationship with the energy service provider. The nature, origins and determinants of both production cost savings and transaction costs are identified, and a number of hypotheses proposed regarding the suitability of different energy services for outsourcing. An approach to testing these hypotheses is briefly described. Finally, Section 5 highlights the implications of the analysis for the contribution of energy service contracting to a low carbon economy.

2 The nature of energy service contracting

Energy service contracting is an umbrella term for a variety of contractual relationships between energy service providers and energy using clients. The terminology used to describe these contracts has varied over time and between countries, and a commonly accepted classification scheme has yet to become established. As a result, it is difficult to assess the overall size of the industry and to demarcate the boundaries between energy service contracting and other commercial activities. The nature, focus and scale of contracting also varies widely between different countries, and the 'US model' that dominates the literature differs in a number of respects from the typical approach used within Europe.

This section describes how the energy services model differs from other types of contract and develops a general method of classifying energy service contracts according to their *scope, depth* and method of *finance*. It shows how choices for each of these variables can influence the responsibilities assigned to each party, together with the allocation of incentives and risks. The aim is to provide a clear understanding of the purpose, content, structure and implementation of energy service contracts, before explaining this in more theoretical terms in Section 4.

2.1 Defining an energy service contract

2.1.1 What are energy services?

In its broadest sense, the term 'energy services' could refer to any service that requires the use of energy: for example, heating, motive power, transportation and computing. But this is unhelpful since practically all services require energy in some form. For example, energy is required for hairdressing and information technology, but here the energy inputs are secondary to labour and capital. Hence, the term 'energy services' is best applied to those services where energy is a 'dominant' input in financial terms and when dedicated conversion equipment is required. This definition is imprecise, but clearly includes services such as space heating, lighting, refrigeration, motive power and high and low temperature process heat.

Energy services are supplied through physical systems that are both internal and external to the energy-using organisation. The 'external' systems include the technologies and infrastructures for extracting, distributing, converting and delivering marketable energy commodities such as gas and oil. The 'internal' systems include the technologies and infrastructures for converting these commodities into final energy services, such as heat and light. These include primary conversion equipment such as boilers and CHP plant; secondary conversion equipment such as radiators and light bulbs; equipment for distributing energy throughout the site, such as pipe-work and transmission lines; and manual or electronic controls. The provision of energy services through these systems involves a number of organisational activities such as the design, installation and commissioning of equipment; the operation and maintenance of that equipment; the financing of new and replacement investment; and compliance with legal requirements such as health, safety and environmental regulation.

Energy services such as space heating and lighting can be provided actively by the conversion of marketable energy commodities such as gas and electricity, but they can also be provided 'passively' by sunlight mediated through the orientation and structure of buildings. So here the relevant energy systems include building fabric, thermal insulation, natural ventilation systems and glazing - and possibly other passive technologies such as geothermal heat. In the future, technologies such as solar photovoltaics may become integrated into building structures and thereby contribute to the on-site supply of electricity (Patterson, 1999). The provision of energy services is therefore a complex activity involving a wide range of physical assets and organisational activities that routinely overlap with other 'non-energy' assets and activities.

2.1.2 What is energy service contracting?

Some of the organisational activities required for the provision of energy services may be conducted by the end-user, but many will involve contracts with external companies such as technical consultants, engineering firms, equipment suppliers and contract maintenance firms. Bertoldi *et al* (2005) use the general term *Energy Service Provider Companies* (ESPCs) to refer to these companies and it is standard practice for energy-using organisations to use several EPSCs for the provision of each type of energy service. For example, an air conditioning unit may be purchased from one company, maintained by a second and operated in-house.

Energy Service Companies (ESCOs) are commonly understood to be a <u>subset</u> of ESPCs engaged in the <u>outsourcing</u> of energy management activities. Outsourcing is defined here as the transfer of the decision rights over some of an organisation's recurring internal activities to an outside contractor. These decision rights are established by the terms and conditions of a long-term contract. Outsourcing *may* involve the transfer of property rights to physical assets, but this is not a necessary feature of an outsourcing contract. The outsourcing services offered by ESCOs are termed *Energy Service Contracts* in this report, but this is an umbrella term for a wide range of contract types. The terms more commonly employed within the energy services industry include:

- Performance contracting (US)
- Energy Savings Performance Contracting (US Federal Energy Management Programme)
- Facility contracting (Germany)
- Chauffage (France)
- First in, First out (Canada)
- Third Party Financing (Austria, Germany, European Commission)
- Contract Energy Management (UK)
- Energy Asset Outsourcing (formerly used by Enron)
- Infrastructure Management (RWE Solutions)

The definition of these terms is varied, making it difficult to specify how one type of contract differs from another or how energy service contracting in general differs from the more conventional contracts offered by EPSCs. UK practitioners use the term *Contract Energy Management* (CEM), which is defined by the Energy Systems Trade Association (ESTA) as:

> '…managing some aspects of a clients' energy use under a contract that transfers some of the risk from the client to the contractor (usually based on providing agreed 'service' levels).'[1]

Hence, according to ESTA the distinguishing feature of an energy service contract is the transfer of risk from the client to the contractor. How much risk and of what type is not specified, but is normally understood to include the technical risk associated with equipment performance. This goes beyond standard warranties for equipment malfunction to include incentives to maintain and improve equipment performance on an ongoing basis. UK CEM companies are members of the Contract Energy Management Group of ESTA, which is itself an umbrella trade association for a broader group of ESPCs. Members of the CEM Group provide a variety of services to clients, but only a subset of these contracts meet ESTA's definition of CEM. Members of ESTA tend to refer to themselves as 'contractors' rather than 'ESCOs', so these two terms will be used interchangeably in what follows.

The US literature also highlights risk transfer as a distinguishing feature of an energy service contract. For example:

> '….The ESCO genus is limited to companies that absorb specific types of risk associated with energy efficiency projects. These risks - tied to project design, project performance, energy price uncertainty and (in some cases) client solvency – are ones clients and financing sources would face were they to undertake energy efficiency projects themselves.' (Rufo, 2001)

However, an important difference between the UK and US definitions quoted above is that the latter refers to *energy efficiency* projects, rather than energy service activities more broadly. This reflects an important difference between the two markets that is discussed further below.

Neither of the above definitions requires the ESCO to finance any investment. However, several organisations and commentators use the term *Third Party Financing* (TPF) interchangeably with energy service contracting. For example: Egger and Öhlinger (2003) describe recent initiatives to promote ESCOs in Austria as Third Party Financing; the United Nations Environment Programme use the term when promoting the concept in developing countries (Poole and Guimaraes, 2001); and the European Commission use the term in both legislation (e.g. Directive 93/76/EC) and research activities (Starzer, 2000). This is perhaps unhelpful, since many existing energy service contracts do not involve third party financing. For example, the investment may be funded through the working capital of the host organisation or the ESCO may simply take over the operation of existing equipment. At the same time, the potential for third party financing is a major attraction of energy service contracting for many clients and it plays an important role in both the US and European markets.

Energy service contracting is most established in the United States, where the term *Performance Contracting* is employed (Singer, 2002). The World Energy Efficiency Association (WEEA) (1999) defines performance contracting as:

> '…providing 'energy savings' to a customer for a fee, the level of which depends upon the amount of energy saved.' (WEEA, 1999)

[1] http://esta.kiwi.co.uk/

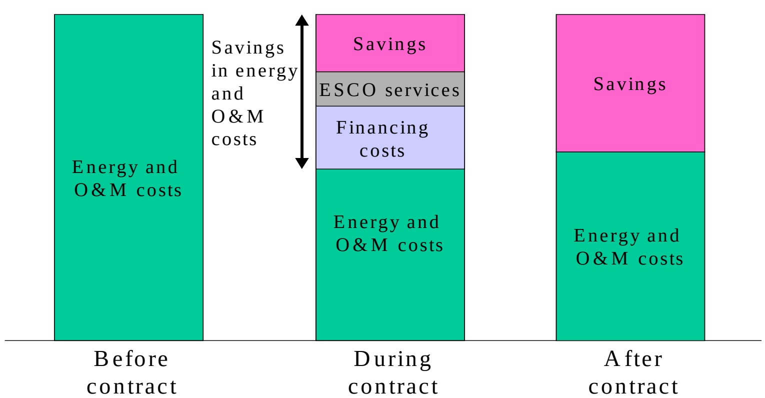
The term ‘energy savings’ points to the fact that performance contracts normally involve improvements in the efficiency of energy use, and are neither confined to, or necessarily involve the supply of heat and electricity through boilers and CHP equipment. WEEA also state that performance contracting involves:

- Comprehensive services, including feasibility analysis, design, engineering, construction management, installation, operation, maintenance, and financing.
- Compensation based upon measured results.
- Transfer of the majority of technical, financial and operational risks to the contractor.

ESCOs are then defined as companies that provide performance contracting as a core part of their business (Goldman, Hopper *et al.*, 2005, p.3). Singer (2002) employs a similar definition of performance contracting, but also highlights the long-term nature of the contracts and the fact that the ESCO typically guarantees a particular level of energy cost saving.

Figure 2.1, which is taken from the US Federal Energy Management Programme (2001), illustrates the financial logic of a performance contract. The investment in energy conversion, distribution and control equipment lowers the production cost of supplying energy services – where the latter includes the cost of purchasing energy commodities and the operation and maintenance costs of the equipment. These savings are used to cover the financing cost of the investment, with the remainder being shared between the ESCO and the client. The contractor has an incentive to maximise savings during the lifetime of the contract, while the client is usually guaranteed a minimum level of energy or cost savings. When the contract comes to an end, all the savings go to the client.

Figure 2.1 Cash flows for a performance contract



Source: FEMP (2001)

2.1.3 A definition of energy service contracting

The above discussion illustrates that energy service contracting has a variety of definitions. Nevertheless, a <u>necessary</u> feature of an energy service contract appears to be:

the transfer of decision rights over key items of energy equipment under the terms and conditions of a long-term contract, including incentives to maintain and improve equipment performance over time

In a conventional 'design and build' or 'turnkey' project, the contractor is responsible for design, specification, construction and commissioning and is paid on project completion. The contractor may be liable if the equipment does not work or does not perform to specification, (although this may require legal proceedings to enforce), but the contractor is rarely involved in operating the equipment and has neither the incentive nor the means to optimise equipment performance subsequent to project delivery. In contrast, an energy services contract establishes a link between contract payments and equipment performance and schedules these payments at intervals over a long-term period (typically, a minimum of 3 years). This provides the contractor with a long-term responsibility for ensuring equipment performance, coupled with an incentive to improve that performance over time (i.e. payment by results). As a result, more of the performance risk of the relevant equipment is transferred to the contractor.

Energy service contracts normally begin with an energy audit, similar to those undertaken by energy consultants. But while a consultant is paid a fixed fee for providing recommendations, the ESCO is paid for the results achieved following implementation of those recommendations. Again, the ESCO carries the risk of projects not performing to expectations, while the energy consultant does not.

Certain other features are common to many energy service contracts, including:

- *Scope*: the contractor may assume decision rights over a significant proportion of the useful energy streams and final energy services within the host site.
- *Depth:* the contractor may assume decision rights over a significant proportion of the organisational activities required to provide those streams and services.
- *Investment*: the contractor may (and usually does) provide new energy conversion, distribution and/or control equipment for the client site.
- *Finance*: the contractor may finance this investment, or assist in obtaining finance for the client.
- *Ownership*: the contractor may assume property rights over some of the assets required to provide energy services.
- *Guarantees*: the contractor may guarantee a particular level of savings in energy consumption or energy costs.
- *Risk*: the contractor may take on the majority of the risks related to the provision of energy services, including equipment performance risk, energy price risk and credit risk.

However, none of these appear to be essential features of an energy service contract. For example, it should be possible to establish a contract that is relatively limited in scope (e.g. confined to heat supply from boilers), does not include third party financing (e.g. investment is financed by the client), does not guarantee a particular level of energy cost savings and does not transfer legal ownership of the assets. But if the performance incentive condition were still met, this would still qualify as an energy service contract.

2.1.4 A method of classifying energy service contracts

The above definition of energy service contracting is very general and encompasses a wide range of contract types offered by an equally wide range of organisations - not all of which would describe themselves as ESCOs. At one extreme, an ESCO could take over the management and operation of the entire energy infrastructure for a public or commercial building, while at the other extreme a vendor of a particular type of energy equipment (e.g. air compressors) could combine turnkey supply with ‘value-added services’ that amount to a performance contract for a single energy service. Both qualify as energy service contracts under this definition, but have rather different implications for cost savings, incentives and the transfer of risk.

To provide a means of comparing these different types of contract, it is proposed here that all energy service contracts can usefully be described by just three variables, namely:

- Contract Scope: What is included
- Contract Depth: How it is included
- Contract Finance: How any new investment is paid for

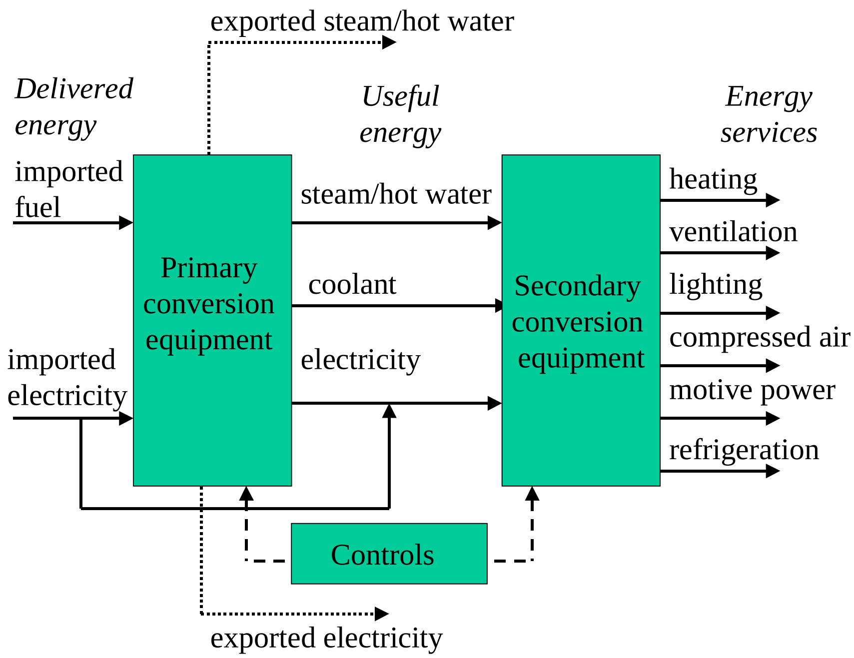
The next section discusses contract scope and contract depth more detail. Section 2.3 discusses contract finance.

2.2 The scope and depth of an energy service contract

2.2.1 The scope of a energy service contract

The **scope** of an energy services contract defines what is included in terms of energy technologies and systems. This may be illustrated with the help of Figure 2.2, which shows the energy flows within a general customer site. Here, *delivered energy* represents energy commodities such as coal, gas and electricity, which are traded through conventional energy markets. Primary conversion equipment, such as boilers and CHP plant converts the delivered energy into various forms of *useful energy,* such as steam, hot water and coolant. In turn, secondary conversion equipment such as radiators, fluorescent lighting and machining equipment converts the useful energy into final *energy services*, such as space heating, light and motive power. Electronic controls are standard for both types of conversion equipment and frequently link the two. These controls may be dedicated to a single useful energy stream or final energy service (e.g. lighting), or may coordinate the delivery of several energy streams and/or services (e.g. Building Energy Management Systems, or BEMS).

Figure 2.2 Final energy, useful energy and energy services within a client site



This framework allows the scope of an energy service contract to be defined as:

the number of useful energy streams and/or final energy services that are wholly or partially under the control of the contractor.

In general, a contract will include one or more streams of useful energy, and/or one or more types of final energy service. At one extreme, a contract could include a single useful energy stream or a single final energy service, while at the other extreme a contract could include all the useful energy streams and all the final energy services for an entire site.

2.2.2 The depth of a energy service contract

While contract scope defines *whether* an individual useful energy stream or final energy service is included; contract **depth** defines *how* they are included. For an individual useful energy stream or final energy service, contract depth may be defined as:

the number of organisational activities required to provide that stream or service that are under the control of the contractor.

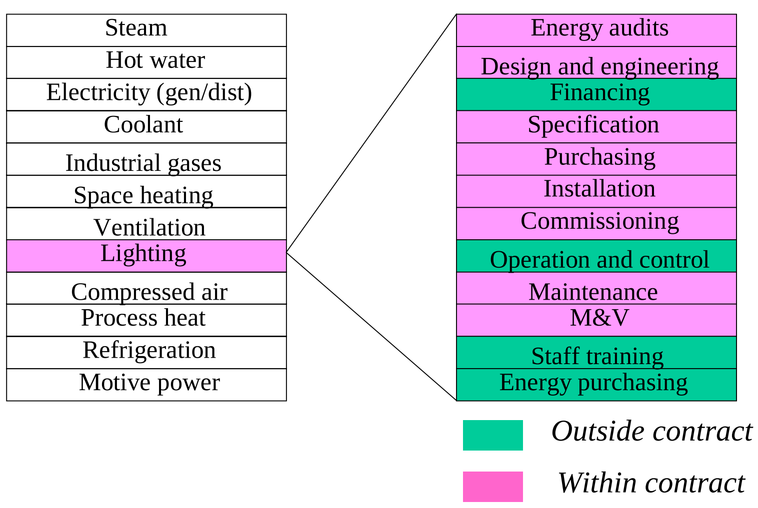
The relevant organisational activities include:

- Purchase of energy commodities (fuel, electricity);
- Energy audits to identify opportunities to improve efficiency;
- Project design and engineering;
- Project financing;
- Equipment specification and purchasing;

- Installation of equipment;
- Commissioning of equipment;
- Operation and control of equipment;
- Maintenance of equipment
- Monitoring and verification of equipment performance;
- Staff training

In principle, contract depth needs to be defined separately for each of the useful energy streams and final energy services that are included within the contract scope (Figure 2.3). This is because contract depth may vary from one stream or service to another. For example, the contractor may be responsible for all of the above activities as they apply to the heating system, but may be only responsible for equipment maintenance for the lighting system. If, however, contract depth is relatively uniform across the streams and activities that are within the contract scope, the term may be used to refer to the contract overall. By definition, contract depth is 'zero' for those services and streams that are not within the contract scope.

Figure 2.3 Contract depth for a single final energy service

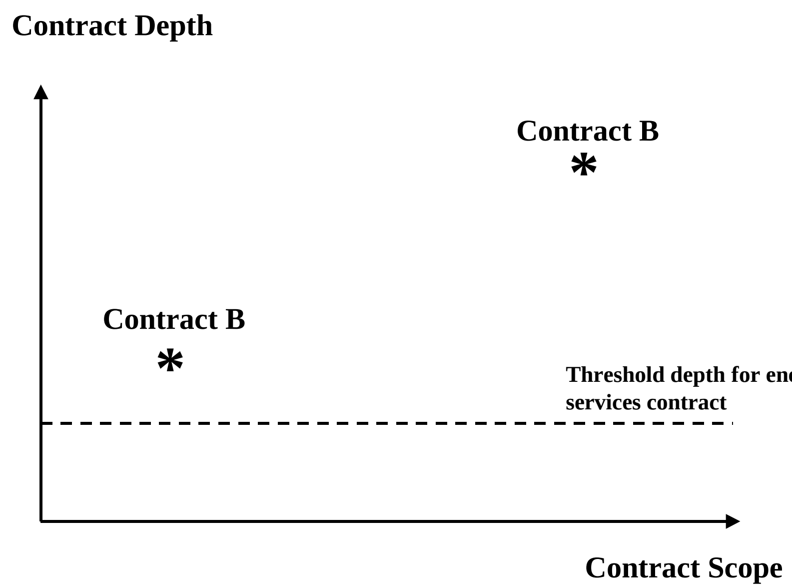


This definition of contract depth assumes that the individual organisational activities are either under the control of the contractor or under the control of the client. In practice, some sharing of control is likely to take place, but one party is nevertheless likely to play a dominant role. Similarly, since final energy services are provided by a combination of 'downstream' (secondary conversion) and 'upstream' (primary conversion) technologies, the notion of contract depth for these services should in theory refer to both. It is more useful, however, to restrict the definition to those organisational activities directly associated with the downstream technologies. Organisational activities associated with the upstream technologies may be included in the measurement of contract depth for the relevant useful energy stream(s).

2.2.3 Combining scope and depth

The combination of contract scope and contract depth is illustrated in Figure 2.4. Here, Contract A represents a 'shallow' contract with relatively 'narrow' scope, while Contract B represents a 'deeper' contract with relatively 'wide' scope.

Figure 2.4 The scope and contract depth of an energy service contract



Increasing (decreasing) contract scope will increase (decrease) the number of useful energy streams or final energy services that are within the contractor's control. A contract may still qualify as an energy service contract, even if it is confined to a single useful energy stream or single final energy service. Generally, the greater the scope of the contract, the more (less) control the contractor (client) will have over the overall energy system. In the extreme, all the energy systems and services for the entire site may be outsourced.

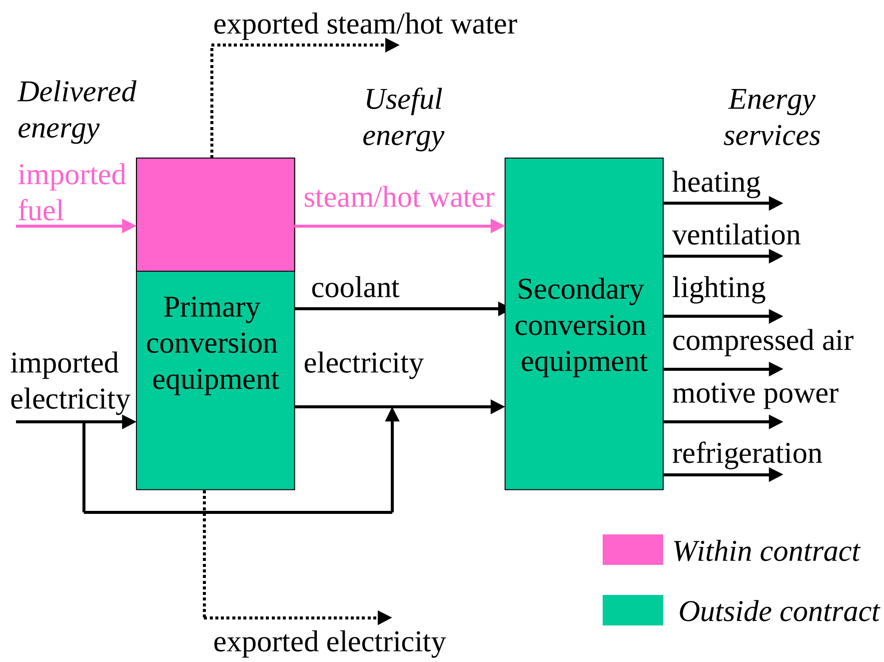
Similarly, increasing (decreasing) contract depth increases (decreases) the control the contractor has over the cost of producing the relevant useful energy streams or final energy services. As illustrated in Figure 2.4, this implies a threshold for contract depth below which a contractor is unable to offer an energy service contract owing to insufficient control over equipment cost, operation and performance. Generally, the more control the contractor has, the less risk it assumes. To support guarantees of equipment performance, the contractor must have substantial control over equipment specification, the selection of the installation subcontractors, operation and maintenance and so on. US experience with energy service contracts suggests that control over operation and maintenance is a particularly important factor.[2]

[2] A study for the US Department Energy revealed that up to 80% of cost savings are due to energy-efficient operation and management practices (Hansen and Weisman, 1998).

2.2.4 The scope of a supply contract

Many of the energy service contracts in operation in Europe may be termed *supply contracts*. These cover one or more streams of useful energy, but do not cover final energy services (Figure 2.5). Hence, the contractor has some control over primary conversion equipment, (such as boilers and CHP) together with the associated control equipment, but little or no control over either secondary conversion equipment or the demand for final energy services. As a result, the contractor has little or no control over the demand for useful energy and only limited control over the demand for delivered energy.

Figure 2.5 Scope of a supply contract



For the contractor, the economic benefits of a supply contract are determined by the difference between the contract revenues and the costs it incurs in providing the relevant useful energy stream(s). For the client, the economic benefits are determined by the difference between the contract payments and the <u>baseline</u> costs it expected to incur in providing the relevant useful energy stream(s) through some other route. If the existing supply equipment is being retired before the end of its natural life, a suitable baseline could be the supply cost prior to contract negotiation. If the existing supply equipment is in need of replacement, a more appropriate baseline would be the estimated supply cost through the cheapest alternative route, such as a turnkey contract combined with in-house operation. In principle, the cost accounting should be comprehensive and should allow for the pricing of various forms of risk, together with the transaction costs incurred for different supply alternatives (Section 4). In practice, the cost accounting may be relatively unsophisticated.

The production cost of providing the relevant useful energy stream(s) will be determined by the:

- demand for the relevant useful energy stream(s);[3]
- capital (financing) costs of any replacement primary conversion, distribution and control equipment;
- technical and operational efficiency of the relevant equipment;
- operation and maintenance costs of this equipment (including staff and materials); and the
- per-unit purchase cost of the relevant energy commodities (including standing and unit charges).

The scope of a supply contract leaves the first of these variables largely outside the contractor's control, while the extent of control over the remaining variables will depend upon the contract depth. Since contractors are increasingly assuming responsibility for fuel and electricity purchasing, they should be able to influence the unit price of the relevant energy commodities.

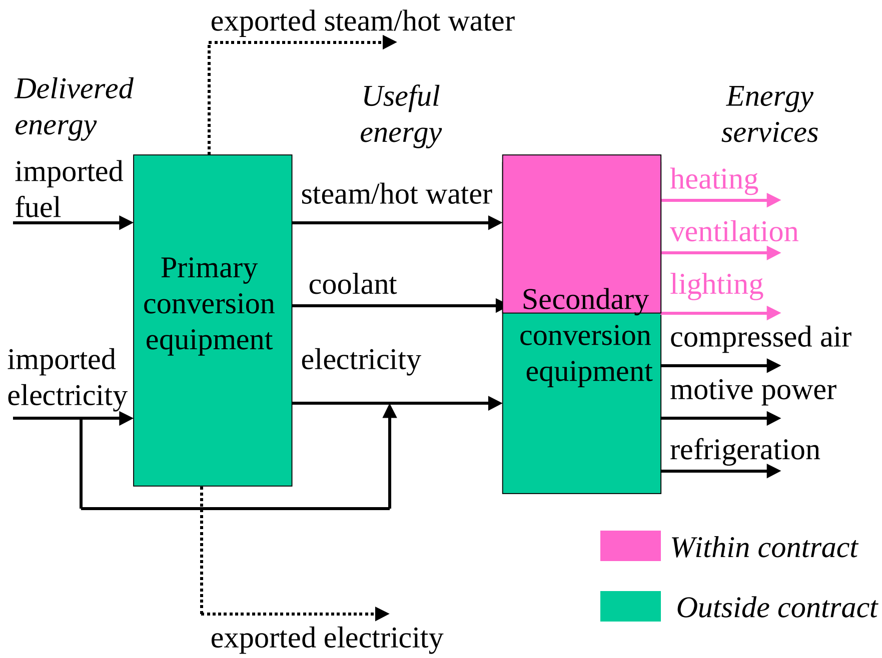
By improving the technical and operational efficiency of primary conversion equipment, a contractor should be able to reduce the demand for delivered energy.[4] Similarly, by a combination of efficiency improvements, lower financing costs, reductions in O&M costs and lower purchase costs for energy commodities, a contractor should be able to reduce the cost of supplying final energy services. However, a contractor is unlikely to *guarantee* either of these, since it lacks control over both the efficiency of secondary conversion equipment and the demand for final energy services. Changes in both of these variables could offset the demand and cost reductions achieved by the supply contract and lead to a net increase in either delivered energy consumption or the total cost of providing final energy services. This is an important limitation of a supply contract, and one that distinguishes it from a more comprehensive performance contract.

2.2.5 The scope of a performance contract

In contrast to supply contracts, *performance* contracts cover one or more final energy services (Figure 2.6). The contractor has some control over secondary conversion equipment (such as lights, radiators, and air conditioning equipment) together with the associated control equipment (such as Building Energy Management Systems, or BEMS). This in turn gives the contractor some control over the demand for final energy services - such as when improvements in lighting controls allow lights to be switched off when a room is unoccupied.

[3] Changes in demand affect both the total and unit cost of supplying useful energy, since the efficiency of conversion equipment will depend upon its load factor.
[4] The installation of CHP plant is more complex as demand for fuel is increased, while demand for imported electricity is reduced. If the CHP plant displaces electricity generation from fossil plant, aggregate national fuel consumption will be reduced, along with national carbon emissions.

Figure 2.6 Scope of a performance contract



This partial control of the demand for final energy services should provide the contractor with partial control over the demand for useful energy and thereby delivered energy. In addition, the performance contract *may* also provide the contractor with direct control of one or more useful energy streams, such as when the replacement and operation of boilers is included within the contract scope (Figure 2.7). This will increase the contractor's overall control of both the demand for delivered energy and the total cost of providing final energy services. In each case, the overall level of control will depend upon both the scope and depth of the contract.

In the most comprehensive performance contracts, the contractor has control of the majority of the useful energy streams and final energy services for the entire site. By combining wide scope with sufficient depth, the contractor can gain control of most of the client's energy system. This approach was pioneered by Enron, and is sometimes referred to as *total energy management* (Figure 2.8).

Figure 2.7 Scope of a more comprehensive performance contract

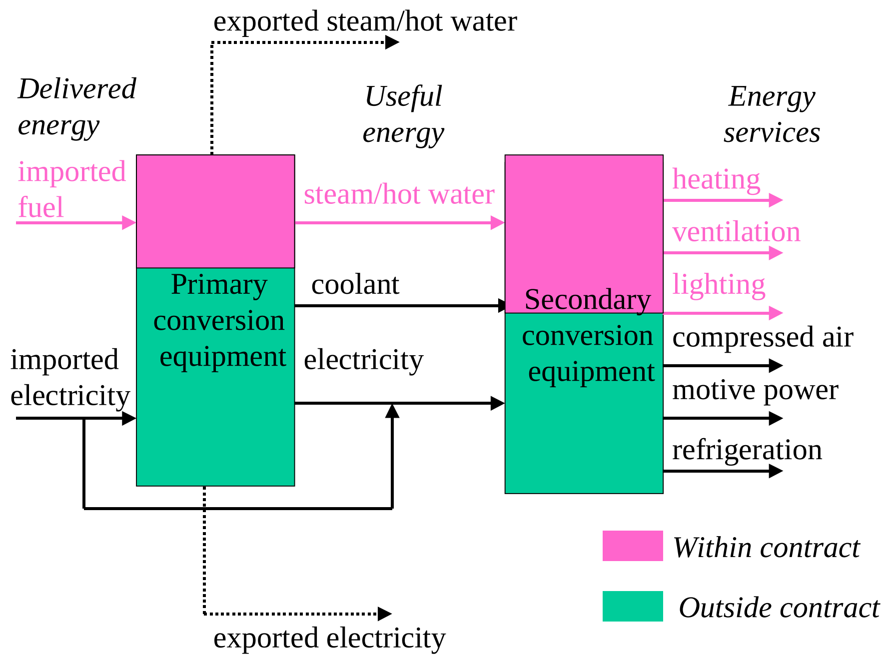
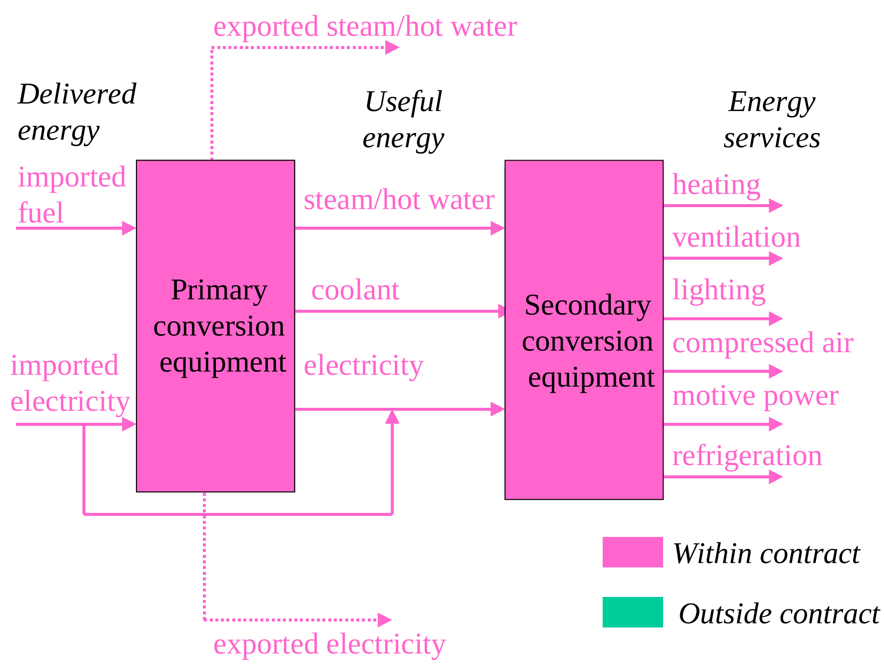


Figure 2.8 Scope of total energy management



The inclusion of one or more final energy services may be considered a necessary feature of a performance contract, while the inclusion of one or more useful energy streams may be considered a contingent feature. Most performance contracts cover several final energy services and seek to combine comprehensive scope with depth. But other contracts cover only a single final energy service (e.g. lighting) and may only cede partial control to the contractor.

For the contractor, the economic benefits of a performance contract are determined by the difference between the contract revenues and the costs it incurs in providing the relevant final energy service(s). For the client, the economic benefits are determined by the difference between the contract payments and the baseline costs it expected to incur in providing those services through some other route. As with supply contracts, the baseline should be a counterfactual scenario that adequately accounts for the pricing of various risks and the relevant transaction costs. But as with supply contracts, this may not always be the case in practice.

The production cost of providing the relevant final energy services(s) should be determined by the:

- demand for the relevant final energy services;
- capital (financing) cost of any replacement secondary conversion, distribution and control equipment;
- technical and operational efficiency of the relevant equipment;
- operation and maintenance costs of this equipment; and the
- per-unit cost of providing the relevant useful energy stream(s).

Performance contracts that are confined to final energy services allow the contractor to influence all but the last of these variables. This in turn will allow the contractor to influence the demand for the relevant useful energy stream(s) and in turn the demand for delivered energy. Performance contracts that cover the relevant useful energy streams in addition to final energy services will also allow the contractor to influence the cost of providing those streams, as well as providing further control over the demand for delivered energy. In this case, the additional variables available to the contractor are the:

- capital (financing) costs of any replacement primary conversion, distribution and control equipment;
- technical and operational efficiency of the relevant equipment;
- operation and maintenance costs of this equipment; and the
- per-unit purchase cost of the relevant energy commodities (including standing and unit charges).

Perhaps the biggest source of cost savings in performance contracts is the reduction in energy purchase costs as a result of reduced energy demand. Hence, a guaranteed reduction in either energy demand or energy purchase costs can form an important element of a such contracts (Hansen and Weisman, 1998). However, this guarantee can only be provided if the contract covers a significant proportion of the final energy services and useful energy streams at the client site. Contracts that are largely confined to heating could guarantee a reduction in the demand for fuel (but not electricity), while those that are confined to electricity could guarantee a reduction in the demand for electricity (but not fuel). But performance contracts that are confined to a single final energy service, or only a subset of final energy services, are unlikely to provide either.

2.2.6 The scope of real-world contracts

The differences between supply and performance contracts are summarised in Table 2.1.

Table 2.1 Comparing two approaches to energy service contracting

Variable	**Supply contracting**	**Performance contracting**
Focus	Useful energy streams (may also include purchasing energy commodities)	Final energy services (may also include useful energy streams and purchasing energy commodities)
Typical sector focus	Industry	Public and commercial buildings
Typical technologies	Boilers, CHP, refrigeration, compressed air, industrial gases	HVAC, lighting, motors and drives, building fabric.
Contract scope	Narrow	Wide
Typical providers	ESCOs Suppliers of primary conversion equipment	ESCOs Suppliers of secondary conversion equipment. Controls companies.
Potential for production cost savings	Low to medium	Medium to high
Anticipated transaction costs	Low to medium	Medium to high
Typical payment terms	Unit price for delivered energy, commonly combined with a capacity charge	Guaranteed reduction in the total cost of providing final energy services *or* a percentage share of the cost savings achieved, both with respect to a specified baseline

Source: Based on (Ramesohl and Dudda, 2001)

But while the distinction between supply and performance contracts is clear in principle, contracts can take a variety of hybrid and intermediate forms in practice. For example, supply contracts often include the provision and operation of electronic controls for both primary and secondary conversion technologies. These controls facilitate the remote monitoring of utilities plant and give the contractor some control over the demand for final energy services (e.g. by controlling space temperatures). Similarly, performance contracts may begin with a single final energy service (e.g. lighting) and then expand over time as the relationship with the client becomes established. As a result, the boundary between supply and performance contracts is blurred and a rigid classification scheme is likely to break down.

It is increasingly common for supply contracts in the industrial sector to extend beyond energy to include water treatment, water supply and wastewater disposal, together with the supply of industrial gases. While conventionally termed energy service contracts, these may be more accurately termed utility service contracts. What is less common is for such contracts to extend into wider *facilities management* activities such as telecommunications, security, cleaning, grounds maintenance, and waste disposal (Blakes Marketing Practice, 1998). In the UK at least, the energy services and facilities management markets appear to be largely separate.

Vendors of secondary conversion equipment are increasingly offering performance contracts focused on a single final energy service. For example, motor equipment vendors are providing ancillary equipment such as controls, sensors and variable speed drives, together with associated service packages such as financing, commissioning, installation, servicing and remote monitoring (Neal Elliot, 2002). Similarly, compressed air suppliers are offering contracts for outsourcing compressed air services, including design, installation, finance, operation and maintenance. While the scope of these contracts is relatively narrow, their depth is comparable to that of a conventional performance contract.

Mechanical and Electrical (M&E) contractors sometimes offer rather similar services to ESCOs, as an extension of their existing project engineering or contract maintenance business. Indeed, many ESCOs have developed from M&E contractors and continue to offer basic maintenance contracts for various forms of industrial and building service equipment.

As Neal Elliot (2002) has argued, both equipment vendors and M&E contractors may have advantages over conventional ESCOs in the industrial market For example, dedicated ESCOs may be an unknown quantity, while vendors and M&E companies may have an existing relationship with the client, together with site-specific knowledge. This existing relationship may leave such companies in a unique position to identify opportunities to improve energy efficiency and to gain support for project proposals from within the client organisation. By offering projects that improve overall productivity, rather than simply lowering energy costs, these companies may attract the attention of key decision-makers more easily. However, a drawback of contracts from equipment vendors is that they are restricted to offering their own type and brand of equipment. In contrast, ESCOs are independent companies that can select and install the most appropriate equipment for each task and can offer a wider range of energy service packages.

2.2.7 The impact of scope and depth on risk

The scope and depth of an energy services contract will play an important role in distributing different risks between the contractor and the client. Both contract revenues and realised savings will depend upon the total cost of providing the relevant stream(s)/service(s), but a range of factors may influence these costs and only a portion of these may be within the contractor’s control. Factors that are outside the contractor's control will increase the risk faced by the contractor, unless they can be monitored and allowed for in some way. Higher risks will translate directly into higher premiums for the client.

2.2.7.1 Terms of payment

The distribution of risks will be mediated through the terms of payment of the contract. In a supply contract, these may be relatively simple. The contract would typically include a *capacity charge* (in £) to cover the contractor’s fixed costs, and a *unit price* (in £/kWh) to cover the contractor’s variable costs. Terms of payment within a performance contract will be less straightforward and may be linked to the method of financing employed (section 2.5). In the US, two commonly used categories are (Singer, 2002, p. 21-22):

- *Guaranteed savings*: Here the client is guaranteed a reduction in the *total* cost of providing the relevant final energy services compared to a specified baseline level. If the actual savings provided by the project fall short of the guaranteed level, the ESCO pays the difference. If the savings exceed the guarantee, the client and the ESCO share the excess according to a formula that depends upon the scope and depth of the contract and the distribution of risks.

- *Shared savings:* Here the client is guaranteed a *percentage* of the savings achieved in providing the relevant final energy services compared to a specified baseline level. The remainder of the savings are paid to the contractor. The client will pay more if the savings are greater than expected, and will pay less if the savings are lower than expected. Since the client is not guaranteed a minimum level of savings, there is a risk that it will make no savings at all compared to the baseline (e.g. if the baseline is historical energy costs and if energy prices rise significantly). Again, the contractor's share of the savings depends upon the scope and depth of the contract and the distribution of risks. A variant of the shared savings contract – termed 'First Out' - allows the contractor to take all of the savings until its investment is recovered, after which the client organisation takes all the savings (Hansen and Weisman, 1998, p. 226). But this approach removes the incentive for the contractor to maximise savings over the long-term

Both supply and performance contracts must distribute four important categories of risk between the contractor and the client, namely construction risk, volume risk, energy price risk and performance risk.

2.2.7.2 Construction risk

Construction risk relates to difficulties in completing any investment projects within time, on budget and according to specifications. For both types of contract, this risk is largely borne by the contractor and is not significantly different from that within conventional turnkey contracts.

2.2.7.3 Volume risk

For supply contracts, volume risk relates to changes in the demand for the relevant useful energy stream(s). If payment is based solely upon a unit charge, the volume risk is largely borne by the contractor, who may not be able to recover its fixed costs should the demand for useful energy fall. A capacity charge allows the contractor to mitigate this risk, which may in turn reduce financing costs and hence the overall cost of supply.[5] In some circumstances the contract may include take or pay clauses, in which the client commits to buying (or more accurately, paying for) a minimum amount of useful energy, even if actual consumption drops below this minimum level.

For performance contracts, volume risk relates to changes in the demand for the relevant final energy service(s). This may result from a variety of factors, such as changes in weather conditions, occupancy patterns, equipment usage and occupant/user behaviour. If none of these factors are allowed for when calculating the energy cost savings, the volume risk will be entirely borne by the contractor. To avoid this, it will be necessary to analyse the determinants of service consumption when specifying the baseline, to monitor those determinants during contract execution and to allow for any changes in those determinants when calculating energy savings. However, the contractor may still carry the risk that some of the determinants are not included in the cost saving formula, or are incorrectly specified.

2.2.7.4 Energy price risk

Energy price risk relates to fluctuations in the price of the relevant delivered energy commodity(s). Supply contracts that fix the unit price for useful energy at a specified level protect the client from energy price risks, while leaving the contractor exposed. Conversely,

[5] The client could therefore benefit if the capacity charge is offset by reductions in the unit price.

supply contracts that index the unit price to the relevant fuel and/or electricity price, will partly or wholly pass on this risk to the client. In some circumstances, an indexed unit price may be combined with a floor price, below which the unit price for useful energy is not allowed to fall. Combined with a take or pay clause, this may mitigate both volume and energy price risks for the contractor, while at the same time reducing the need for a separate capacity charge. It could, however, prevent the client from benefiting from reductions in energy prices.

Similar comments apply to the energy price risk in a performance contract. This risk may be partly or wholly passed on to the client by indexing the savings formula to the relevant fuel and/or electricity price. Changes in energy prices will then be reflected in the baseline energy costs, so that only cost savings from performance improvements are included in the cost saving formula. As with supply contracts, such indexing may be combined with a floor price, which will restrict the applicability of any savings guarantee.

In both cases, the appropriate choice will depend upon the purchasing arrangements for fuel and electricity. Increasingly, contractors are taking over responsibility for energy purchasing or combining energy service offerings with commodity supply contracts from other companies within the same Group. For example, multinationals such Dalkia own both energy service divisions and electricity and gas suppliers. This allows the price and indexing arrangements in the energy service contract to be linked to those in the purchase contract.

Performance risk

The performance risk in a supply contract relates to the technical efficiency, O&M costs and availability of the relevant conversion, distribution and control equipment. The contractor should have an incentive to maximise the technical efficiency and minimise the operating costs of the conversion equipment throughout the contract lifetime. For example, if the unit price for the useful energy stream is fixed, improvements in the technical efficiency of primary conversion equipment should lower the demand for energy commodities, lower the variable costs for the contractor and increase contract revenues. The strength of this incentive will depend upon the specific contract provisions, while the ability of the contractor to respond to those incentives will depend upon the contract depth.

The contractor may be tempted to increase contract revenues by ‘shirking’ on equipment maintenance. But the contractor must also ensure the availability and reliability of equipment, and meet minimum standards for ‘quality’ variables such as steam temperature and pressure. Equipment reliability is likely to be particularly important for industrial clients, since the cost of any production interruptions is likely to greatly exceed the savings in energy costs from a supply contract. Hence, such contracts are likely to include availability standards, maximum response times and penalty provisions for supply outages.

The performance risk in a performance contract is similar: the contractor has an incentive to maximise technical efficiency and minimise operation and maintenance costs, while at the same time meeting standards for equipment availability and service quality. The last presents more of a challenge, however, because service quality may be difficult to measure (Section 4). In buildings, for example, this would include room temperature, airflow, air quality, humidity and lighting levels in different locations. Building owners or operators may prefer to keep some of these factors within their own control (e.g. by opening windows), but this would reduce the contractor's control and thereby increase the contractor's risk. While the contract may be expected to include a variety of standards for service quality and availability, these may prove difficult to enforce in practice.

The performance incentives described above only apply for the duration of the contract. This means that the contractor has little incentive to maintain equipment to a level that will extend its economic life beyond the contract term. Whether this matters in practice will depend upon a range of factors including the assignment of property rights over the equipment, its resale value and the contractor's interest in maintaining a reputation with the client, including the potential for contract renewal (Section 4).

2.3 The financing of an energy service contract

Investment in new equipment is not a necessary feature of energy service contract, but is a common and important feature. Such investment may be financed through a number of routes, each of which has different implications for project feasibility, the cost of capital, the distribution of risk and the terms of payment. The basic choices are:

- Internal financing:
  - Working capital provided by the contractor.
  - Working capital provided by the client.
- Lease financing:
  - Operating lease
  - Capital lease
- Third party financing:
  - Debt undertaken by the client.
  - Debt undertaken by the contractor.
- Project financing.

Third party financing (TPF) tends to be the most common approach for US performance contracts, but the European situation is more mixed. The appropriate choice will depend upon the particular context, including the familiarity of lenders with financing different types of project, the credit status of energy service providers, the credit status of the client, public sector procurement rules and the accounting rules for tax and depreciation. Generally speaking, energy efficiency projects are more difficult to finance than energy supply projects and difficulties in obtaining financing are regularly cited as one of the biggest barriers to developing an energy services market (Painuyly, Park et al., 2003). The following sections briefly outline the pros and cons of each of the above methods.

2.3.1 Internal financing

The client may finance investment from internal sources in situations where it has access to sufficient internal funds and wishes to benefit from the performance guarantees provided by an energy service contract. Typically, however there are multiple demands upon internal capital budgets and cost-saving projects tend to be given a lower priority than business development projects (Box 2.1) (Sorrell, Schleich et al., 2004). Since internal problems with capital budgeting form one of the biggest barriers to improved energy efficiency, client financing from working capital appears to be relatively rare.

Box 2.1 Why firms do not access internal sources of capital for energy efficiency investment

Dedicated energy efficiency investments are frequently classified as 'discretionary business maintenance projects' by private sector firms and thereby given a lower priority than either essential business maintenance projects, such as replacing a failed pump, or strategic business development investments, such as a new manufacturing plant (Department of Energy, 1983).

One reason is the strategic priorities of top management, who tend to be primarily concerned with the long-term survival of their business. This leads to a focus on dynamic factors such as the introduction of new products and the development of new production facilities. Given severe constraints on time and attention, the small cost savings from energy efficiency investments are easily downgraded and overlooked. This is despite the fact that such investments frequently have a higher rate of return than large projects that receive more management attention (Ross, 1986).

The contractor may also finance investment from working capital in situations where the contractor has access to sufficient internal funds and the client is unable or reluctant to take on borrowing. This may apply, for example, to large, multinational contractors undertaking projects for public sector organisations in the EU, for whom access to capital is restricted. However, this option is unlikely to be available to smaller contractors or those just starting up.

While internal financing reduces the exposure to risk from changing interest rates, it appears to be relatively uncommon in the US (WEEA, 1999). This is partly because it leaves the contractor exposed to the 'credit risk' of the client – i.e. the risk that the client will go out of business and the project will lose most or all of its value. At the same time, internal ESCO financing appears to have been widely used in European energy service contracts (Bertoldi and Rezessy, 2005). The difference appears to result from a combination of the difficulties client's face in obtaining loan finance for energy efficiency projects in Europe, the severe constraints on borrowing in the European public sector, and the reluctance of private sector clients to take on additional debt (Bertoldi and Rezessy, 2005). The last is a particularly complex issue that can inhibit energy service contracting as much as it does in-house financing of energy efficiency (Box 2.2).

Box 2.2 Why firms do not access external sources of capital for energy efficiency investment

Firms are often reluctant to borrow money to finance low risk energy efficiency projects with rates of return that appear to significantly exceed their weighted average cost of capital (WACC). This results in part from the perceived risk of increasing the ratio of loan finance to equity finance ('gearing'). Loan finance should be valuable up to a point, since it tends to be cheaper than equity – historically, the expected returns from equities are higher than those from loan stocks, and loans tend to have a more favourable tax treatment. But loan finance carries risk in that it imposes obligations to meet annual interest charges and to repay the principal. Unlike share dividends, these are fixed obligations and are not at the firm's discretion. High levels of gearing may therefore expose the firm to the risk that it will not be able to meet its payment obligations should it experience a downturn in business.

With loan finance, the lenders have the legal right to enforce payment of the interest and repayment of the capital, using the assets of the company as security. In contrast, ordinary shareholders do not have the right to enforce the payment of a dividend. This situation means that high levels of gearing may expose the shareholders to greater risk as all the firm's profits could be eaten up in debt repayments. As result, shareholders may demand higher returns as compensation. Furthermore, high levels of gearing may also expose the *lenders* to greater risk, since the asset value may be insufficient to pay off the outstanding loans should the firm go out of business. Hence, lenders may also demand higher interest payments on loans as the level of gearing increases. The result is that, while loan finance may reduce a firm's cost of capital at low levels of gearing, it may increase risk and raise a firm's cost of capital at high levels of gearing.[6]

Information asymmetry may also play a role in restricting the level of gearing. For example, Jensen (1986) argues that increased gearing may be in the interest of shareholders if it lowers the cost of capital, but may not be desired by company directors because it imposes an unwanted discipline. This could dissuade directors from using external funds to finance cost effective investments. Similarly, Myers and Majluf (1984) emphasised how investors may interpret reliance upon external finance as a signal that the existing assets are overvalued. It is commonly observed that an attempt to raise additional equity finance or to increase the level of gearing can weaken a firm's financial rating and drive down share prices (Asquith and Mullins, 1986). Since debt imposes both greater risk on the firm and greater discipline upon managers, it should have a smaller impact than share issues. But in all cases, the cost of obtaining additional capital may exceed the average cost of the existing debt/equity mix (Ross, 1986). The prediction, therefore, is that firms will: a) prefer internal to external finance; b) prefer debt finance to equity; and c) avoid high levels of gearing (Myers, 2001).

Source: (Sorrell, Schleich et al., 2004)

2.3.2 Lease financing

Lease financing may be an attractive alternative to debt if (as is often the case) the lease payments are lower than the equivalent loan payments. However, a necessary condition for leasing is the 'fungibility' of the relevant equipment – i.e. the possibility that a third party can profitably use it (Ostertag, 2003, p. 289). For example, a packaged boiler system may be relatively fungible while the associated heat distribution system may not. This means that leasing will be restricted to certain categories of equipment and may not be appropriate for all projects, or even for all items within a single project.

[6] This traditional view of an 'optimal' level of gearing was challenged by Modigliani and Miller (1958), who showed that, given a set of assumptions about the operation of capital markets, the advantages of cheaper loan finance should be exactly offset by the increasing cost of equity. As a result, the WACC should be independent of the level of gearing and should depend solely upon business risk and future cash flows. But this model effectively assumes that the transaction costs within capital markets are zero. Also, the result is not supported by the empirical evidence, which shows a reluctance to increase gearing beyond a particular level.

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Contractors can arrange an appropriate lease agreement between a client and a leasing company. A *capital* lease is analogous to the instalment purchase of equipment, with ownership passing to the client at the end of the lease term (Bertoldi and Rezessy, 2005, p. 20). In contrast, an *operating* lease is analogous to the rental of equipment, with the leasing company retaining ownership throughout. However, many operating leases give the client the option of purchasing the equipment at fair market value at the end of the lease term (Singer, 2002). A key difference between the two is that capital leases lead to an asset and a liability appearing on the client's balance sheet, while an operating lease provides off-balance sheet financing. The downside of operating leases is that the client is unable to benefit from any tax allowances for depreciation (Box 2.3). The majority of energy equipment leases are capital leases.[7]

Box 2.3 The UK scheme for enhanced capital allowances for investment in qualifying energy efficient technologies

Enhanced Capital Allowances provide a form of tax relief on profits to encourage investment in energy efficient technologies. The scheme builds on existing provisions, under which businesses may obtain tax relief, in the form of capital allowances, for their investment in machinery and plant. This relief is normally given at a rate of 25% a year on the reducing balance basis, which means that 95% of the cost is relieved in 8 years. Enhanced capital allowances enables businesses to take relief on the full cost in the first year. The benefit is an improved cash flow for the business in the year in which the investment is made, while having a neutral impact on overall tax revenue. ECAs have been made available for investment in CHP, boilers, motors, variable speed drives, lighting, refrigeration, pipe insulation materials and thermal screens, provided they meet relevant, technology-specific energy efficiency criteria. The criteria are reviewed annually and other technologies may be added in the future. Suppliers of individual technologies must apply to have their products certified. Investment in buildings and structures is excluded.

2.3.3 Third party financing

The most common source of financing in US performance contracts is debt taken on by either the client or the contractor. The US literature uses the term *guaranteed savings* to refer to contracts where the client takes on debt and *shared savings* to refer to contracts where the contractor takes on debt. But while this is a commonly used terminology, it is rather unhelpful. By focusing on the treatment of cost savings, it tends to obscure the fact that the key issue is the source of finance. It also obscures the fact that guaranteed savings contracts may also involve ‘sharing’ of savings, and that both sharing and guarantees of savings can apply to contracts where neither party undertakes on additional debt.

2.3.3.1 Lenders’ perspective

With debt finance, lenders will require assurance that there will be sufficient revenues to meet the repayment terms. This will depend in part upon the performance of the project over time. Energy service contracts have an advantage here, since the contract is associated with performance incentives and guarantees, which may lower the risk to the lender and thereby facilitate lower cost financing. However, lenders generally require security for the loan to be based upon the assets of the client or the contractor, since the anticipated energy savings are

[7] Capital leases are commonly used when the lease term meets or exceeds 75% of the equipment’s economic life and the present value of the lease payments is equal to 90% or more of the market value of the equipment.

rarely regarded as sufficient (or indeed any) security in their own right. Similarly, assessment of credit risk will largely be based on the internal company (not project) cash flow available to service debt repayments (Goss Gilroy Inc., 1995). This means that the performance guarantees of energy services contract are very much secondary to the overall assessment of credit risk for the contractor or for the client. As a consequence, the feasibility of third party financing will depend upon the overall situation of the contractor and the client, rather than the performance characteristics of the individual project. For example, a small ESCO may be unable to obtain a financing for a promising performance contract if it has insufficient assets to pledge as security.

2.3.3.2 Debt undertaken by contractor

In the early 1980s, US energy service contracts primarily relied upon contractors taking on debt to finance the investment. But with this arrangement ('shared savings'), the contractor takes on the risk of repaying the debt should the client go out of business. To compensate for this increased risk, the cost of capital will be higher and the contractor will require higher returns. This in turn may confine such contracts to projects with relatively short paybacks. While the client avoids the obligation of regular debt repayments, it is likely to receive a smaller share of the cost savings and is less likely to be guaranteed a particular level of savings. Furthermore, additional contracts will increase the debt-to-equity ratio ('gearing') of the contractor and thereby increase its cost of capital (Box 2.2). This could place a ceiling on the number of such contracts the contractor is able to undertake, unless it is very large or is bought out by a larger company, such as an energy utility (Singer, 2002).

2.3.3.3 Debt undertaken by client

In contrast, if the client takes on the debt obligations ('guaranteed savings'), the contractor will only be responsible for the equipment performance risk. While the client takes on the obligation of regular debt repayments, the contractor can help to arrange the finance and can guarantee that the energy cost savings will provide the cash flow to repay the loan (provided that energy prices do not fall below a specified level). While the cost of capital will be largely determined by the credit risk of the client, the guarantee that energy cost savings will cover debt-service obligations may encourage the lending institution to offer more favourable terms. In addition: the cost of capital for many clients should be lower than that for the contractor; the lending institution should be better placed than the contractor to assess the client's credit risk; and the contractor should be in a better position than the lender to assess the project's performance risk.

The combination of lower financing costs, a greater share of the energy cost savings and the security provided by the savings guarantee can make this option more favourable to clients. The main disadvantage is that the debt must appear on the client's balance sheet, which in turn may affect its ability to borrow for other purposes. Clients that are unwilling or unable to take on additional debt are unable to benefit from this form of finance.

2.3.3.4 The appropriate choice for third-party financing

The appropriate choice between the above two options will depend upon individual circumstances. US ESCOs had a bad experience in the 1980s, when falling energy prices meant that contract payments were insufficient to repay the loans they had undertaken for individual projects. This led to a shift towards clients taking on debt obligations, encouraged by a guarantee of cost savings but with the contractor's risk mitigated by the use of 'floor prices' for energy commodities (Hansen and Weisman, 1998). Today, around 95% of the performance contracts in the US involve the clients taking on debt, and this approach has proved particularly attractive in the public sector where clients qualify for tax-exempt loans. The same is not true in Europe, however, where government procurement, accounting and budgeting rules have led many public sector organisations to seek off-balance sheet financing (Sussex, 2001). This difference goes a long way to explain the differing size and focus of the US and European energy service markets (Section 3).

Table 2.2 compares the relative merits of the two approaches.

Table 2.2 Financing investments within energy service contracts

Client finances investment through debt	**Contractor finances investment through debt**
Client has separate contracts with ESCO and finance company	Client has single contract with ESCO ESCO has separate contract with finance company
Assets appears on client's balance sheet	Assets appears on ESCOs balance sheet
ESCO assumes performance risk	ESCO assumes both performance and credit risk
Lower cost of capital	Higher cost of capital
Higher proportion of energy cost savings to client	Lower proportion of energy cost savings to client
Lower proportion of energy cost savings to ESCO	Higher proportion of energy cost savings to ESCO
Increases debt-equity ratio for client	Increases debt-equity ratio for ESCO
Favours projects with longer paybacks	Favours projects with shorter paybacks
Feasible for small ESCOs	Only feasible for large ESCOs
Requires creditworthy client	Can serve clients that have difficulty accessing financing

Source: Based on (Singer, 2002)

2.3.4 Project financing

The final option, project financing, is similar to the model for financing electricity generation projects and is only feasible for the very largest energy service contracts. The ESCO joins with providers of risk capital and possibly the client itself to form a ‘special purpose vehicle’ (SPV) or joint venture company to implement the project. Finance is provided by equity from the ESCO, equity from risk capital investors and debt from banks. The debt finance is arranged by the SPV on a project basis, which means the lenders do not have recourse to the assets of either the client or the ESCO. Instead, repayment is limited to the cash flow generated by the project itself, while lender security is confined solely to the assets of the project. Project sponsors are normally keen to maximise leverage, which means that debt usually accounts for 70-80% of the total capital cost. The energy service contract with the client provides some security for the lenders, but in practice the banks apply stringent criteria on the credit risk of the client.

An SPV is a complex arrangement, with the web of interconnecting obligations and commitments leading to substantial transaction costs. It does have advantages, however, since it insulates both the ESCO and the client from the risk of project failure as well as removing the project from their balance sheets. The attraction to lenders is that their funds are clearly devoted to the project itself, rather than being used elsewhere within the ESCO or client firm.

While project finance is a relatively common route for large CHP projects in Europe, it has rarely been applied to end-use efficiency or performance contracts. The key reason appears to be the difficulty lenders have in recognising ‘energy cost savings’ as a security for a loan. The situation is different for supply contracts, since the payment terms (capacity charge and unit price) are analogous to those in a conventional electricity generation project and hence more familiar to lenders. This points to a more general issue regarding the financing of energy efficiency projects: greater progress could potentially be made if the projected cash flows from such projects could be grouped into portfolios and traded as securities on financial markets (Mills, Kromer et al., 2005). At present, such developments are in their infancy, even within the US.

2.4 The terms of an energy service contract

The scope, depth and method of finance of a contract will largely determine the division of responsibilities, incentives and risks between the client and contractor. These features take a practical form in (and can be modified by) the *terms* of a contract, which must be carefully designed and monitored if both parties are to benefit. Typically an energy service contract contains a general section that outlines the nature of the agreement in broad terms, together with a series of individual schedules or attachments that establish precisely what is to be done, how savings are to be calculated, how payments are to be made and so on (Hansen and Weisman, 1998, p. 86). These schedules may be either proprietary or standardised depending upon the scope and depth of the contract and upon the individual client circumstances. Table 2.3 lists some of the factors to be taken into account when developing such a contract.

Table 2.3 Key considerations within an energy service contract

Area	**Issues**
New equipment	Specification; selection; cost; responsibility for installation and commissioning.
Equipment ownership	Rights during and after contract; buyback provisions;
Maintenance	Division of responsibilities, monitoring
Operation	Division of responsibilities, monitoring; coordination
Performance and quality standards	May range from pressure and temperature in the case of steam, to complex mix of comfort standards in the case of buildings (e.g. temperature, lighting levels, air exchange, user control)
Reliability standards	Maximum downtime; provisions for immediate and backup service in the event of malfunction.
Service standards	Acceptable parameters for temperature, lighting, air exchange and other factors
Monitoring and verification	Methods for monitoring and verifying energy consumption and savings, including use of standardised protocols
Calculation of cost savings	Baseline energy consumption and operating conditions; assumptions; formulae; adjustment for factors beyond the contractor’s control
Pricing and payment provisions	Fixed and variable components of pricing; guarantees to client; division of savings
Adjustment to external changes	Adjustment to inflation, changes in energy prices and other factors
Provisions for early termination	Buyout provisions; compensation; equipment removal provisions; restoration of facility
Other	insurance; dispute resolution; penalties for contract breach; force major; etc.

Source: Based on Hansen and Weisman (1998)

A particularly important feature of an energy service contract is the method for monitoring and verifying energy cost savings. This includes the process for: a) establishing baseline energy consumption and costs (either historical or counterfactual); b) monitoring and verifying the actual consumption and costs; and c) calculating the corresponding *saving* in consumption and cost, including appropriate adjustments to allow for changes in various internal and external factors. As an example, the factors influencing energy costs within a public or commercial building include: operating hours and occupancy patterns; weather conditions; degradation in equipment performance over time; compliance with new health, safety and environmental standards; building closures; increases in passive heat generation owing to greater use of IT equipment and so on.

Monitoring and verification (M&V) is much more straightforward for supply contracts than for comprehensive performance contracts, but in all cases a trade-off between cost and accuracy is required. While inadequate monitoring may leave the client vulnerable to opportunistic behaviour by the contractor, excessive monitoring can offset the savings in energy costs, while offering little return on investment. The appropriate level will depend upon the expected saving in energy costs, the extent to which better monitoring is expected to increase the size of persistence of those cost savings and the capital and operating cost of different M&V options. M&V costs that exceed, say, 10% of the saving in energy costs are unlikely to be appropriate.

The importance of adequate monitoring and verification has long been recognised in the US, where the Department Energy (DOE) has developed the International Performance Measurement and Verification Protocol (IPMVP) (IPMVP, 2001). The original version, published in 1997, established a consensus approach to M&V that aimed to:

- increase the reliability and level of savings and improve the persistence of savings over time, by providing operators with better feedback on operating conditions;
- reduce the transaction costs for both the contractor and the client, by providing an off-the-shelf industry standard;
- reduce financing costs by providing a reliable method of establishing cost savings that lenders could trust and could potentially treat as security for a loan;
- facilitate the participation of ESCOs in project-based emissions trading schemes, by providing a reliable framework for calculating emission reductions; and
- increase the confidence of both public and policymakers in energy service contracting, by improving the credibility of the claimed reductions in energy consumption and emissions (IPMVP, 2001, p. 7).

Extensive operational experience over a number of years has demonstrated the value of this approach, with higher levels of cost savings being achieved over longer periods of time, together with reduced variability of savings between otherwise comparable clients (Kats, Rosenfeld et al., 1997).

The IPMVP incorporates four options for M&V representing different levels of cost and accuracy, which are summarised in Table 2.4. The Protocol is primarily geared to performance contracts in public and commercial buildings, and appears much less appropriate for the supply contracts that dominate in Europe. Following its original development by the US DOE, an independent non-profit company has been established to develop the methodology (e.g. extending it to water savings and to indoor air quality) and to promote it internationally (e.g. by translating it into ten languages). But despite claims that the methodology has been used in more than 40 countries, the take-up in most European countries appears to be very limited (Ramesohl and Dudda, 2001)

Table 2.4 Monitoring and verification options in the IPMVP

Option	Basis of saving calculation	Determinants of cost
Option A: Intended for *individual* energy efficiency measures with a relatively constant load. Physical inspection of equipment to determine whether installation and operation are to specification. Key performance factors (e.g. motors efficiency) are measured on a snapshot or short-term basis. Other operational factors (e.g. motor runtime) stipulated based upon analysis of historical data	Engineering calculations audit heat simulations based upon metered data and stipulated operational data	Number of measurement points. Complexity of stipulation. Frequency of inspection
Option B: Intended for *individual* energy efficiency measures with a variable load profile. Both performance and operational factors are measured on a short-term continuous basis throughout the term of the contract.	Engineering calculations after performing a statistical analysis of metered data	Number of measurement points
Option C: Intended for whole-building monitoring and verification where energy systems are *interactive* (e.g. efficient lighting system reduces cooling loads) rendering measurement of individual measures inaccurate. Performance factors are determined at the whole building or facility level with *continuous* measurements. Operational factors are derived from hourly measurements and/or historical metered or sub-metered data	Engineering calculations based upon a statistical analysis of whole building data using technique from simple comparison to multivariate regression analysis	Number of meters. Number of independent variables needed to account for savings variability.
Option D: Typically employed for verification of saving in *new construction* and in comprehensive retrofit involving multiple measures at a single facility where pre-retrofit data may not exist. Performance and operational factors are modelled based upon design specification. Measurement should be used to confirm simulation inputs and calibrate the models.	Calibrated energy simulation modelling of facility components and/or the whole facility calibrated with utility bills and/or end use metering data collected after project completion.	Number and complexity of systems simulated. Number of field measurements required providing input data.

Source: IPMVP (2001)

2.5 Summary

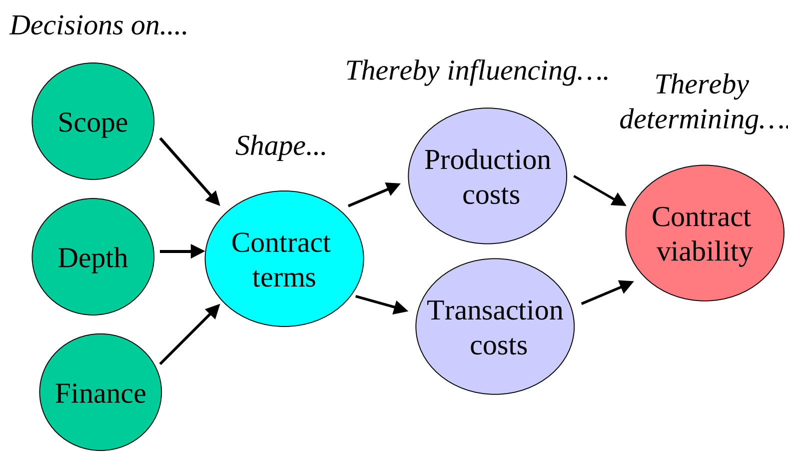
This section has described the purpose, content, structure and implementation of energy service contracts and focused in particular on the distribution of responsibilities, incentives and risks between the contractor and the client. In particular, it has:

- Defined energy service contracting as the transfer of decision rights over key items of energy-related equipment under the terms and conditions of a long-term contract, including incentives to maintain and improve equipment performance over time.
- Shown how a wide range of contracts can meet this definition and how these may be usefully be classified in terms of three easily measurable variables, namely:
    - *Scope*: what is included;
    - *Depth*: how it is included; and
    - *Finance*: how any new investment is paid for.
- Defined the scope of a contract as the number of useful energy streams and/or final energy services that are wholly or partially under the control of the contractor.
- Defined the depth of a contract as the numbers of organisational activities required to provide that stream or service that are under the control of the contractor.
- Shown how the scope of a supply contract differs from that of a performance contract and shown how actual contracts may take a variety of intermediate and hybrid forms.
- Shown how a minimum depth is required for a contact to qualify as an energy service contract.
- Shown how the combination of scope and depth influences the distribution of risks between the contractor and the client, including in particular energy price risks and equipment performance risks.
- Identified the different options for financing new investment in energy service contracts and discussed the pros and cons of each.
- Summarised the additional elements of an energy services contract, including in particular the provisions for monitoring and verification.

The resulting framework is summarised in Figure 2.9. An individual energy service contract can be characterised by the decisions made on scope, depth and method of finance. These variables will largely determine the savings in production costs that can be achieved, together with the transaction costs incurred by both the client and the contractor, although these will be mediated by the specific contract terms. The ratio of production cost savings to transaction costs will determine whether a contract is viable and how successful it is likely to be.

But so far this is largely a descriptive framework. It does not show *how* decisions on, for example, contract scope will affect either production costs or transaction costs and hence fails to explain *why* particular decisions are made. The translation of this descriptive framework into more explanatory model is the subject of Section 4. Before this, Section 3 provides a more detailed account of how the energy services market has developed in the US, Europe and the UK.

Figure 2.9 Scope, depth, finance and contract viability



3 The status of energy service contracting

The energy services market is mature in the United States and Canada, well established in some European countries (e.g. Austria, Germany, France, Hungary), emerging in others (e.g. Spain, Sweden, Italy) and almost entirely absent in countries outside the OECD. This section provides an overview of the energy services market in the US and Europe and looks in more detail at the market in the UK. For reasons described below, this overview is largely qualitative.

3.1 US experience with energy service contracts

Energy service contracting originated in the US, following the oil-price shocks of the 1970s (Singer, 2002). The stimulus was the demand-side management (DSM) programmes imposed by the federal and state governments to reduce aggregate energy demand. The DSM programmes required energy utilities to implement energy efficiency programmes, but they often lacked the required technical and managerial skills. This led to the growth of independent energy service companies that could deliver energy efficiency projects under subcontract to the utilities.

In the 1980s, the DSM programmes evolved into more broad-based Integrated Resource Planning (IRP), which required utilities to evaluate demand-side measures on equal terms with new sources of supply. This expanded the market for ESCOs, which now began to offer comprehensive performance contracts encompassing audit, design, implementation, commissioning, monitoring, maintenance and, most importantly, third-party financing by the ESCO (Singer, 2002). Many of these contracts were based upon sharing the expected savings in energy costs between the contractor and the client. This model worked well up to the mid 1980s, when there was a dramatic fall in energy prices (Hansen and Weisman, 1998, p. 8). This meant it took longer than expected for ESCOs to recover their costs and many defaulted on their commitments. This experience damaged the credibility of the energy services model and reduced market size over the short-term.

However, ESCOs responded to these difficulties by offering more robust contract types and shifting financing obligations to the client, backed by performance guarantees. This approach proved successful and by the late 1980s the market had begun to recover. Large companies such as Honeywell and Johnson began to enter the energy service field, on the back of their existing competence in electronic controls. The market received a considerable boost in the early to mid-1990s by the introduction of legislation at both the federal and state level to encourage performance contracting within public buildings and the Federal Energy Management Programme soon became the biggest driver for increased ESCO activity (Dayton, Goldman *et al.*, 1998, ; Rufo, 2001).

The liberalisation of energy markets from the late 1990s onwards had a mixed effect on the industry. On the one hand, DSM and IRP programmes were reduced as utilities lost their monopoly franchise. On the other hand, the combination of commodity supply with energy efficiency services was seen as a potential means to increase margins within a highly competitive market. This led to independent ESCOs being bought out by electricity and gas utilities, often at values that bore little relation to their current level of profitability. The takeovers were advantageous for the ESCOs, since they increased access to capital and enabled them to expand their activities in those companies and sectors that preferred off-balance sheet financing (Singer, 2002). As a result, by the end of the 1990s nearly all the biggest ESCOs were subsidiaries of utilities or other energy companies.

The expectation that energy service offerings would provide a competitive advantage for utilities has proved to be premature, however. The process of liberalising US energy markets has stalled following the 2001 California electricity crisis (Joskow, 2001) and the long-term effects of liberalisation of the energy services market remain unclear (Goldman and Dayton, 1996). A comprehensive study by Goldman *et al* (2005) estimated that the US performance contracting market grew at an average rate of 25%/year during the 1990s, but this had reduced to 9%/year by 2000.

Despite this apparent slowdown, the US energy services market remains the largest in the world. Goldman *et al* (2005) estimated the annual revenues from performance contracting to be between $0.9 and $1.2 billion in 2000, with an annual investment in energy efficiency projects of $1.8-2.1 billion. Table 3.1 summarises Goldman *et al's* estimate of the market share of four types of ESCO: those owned by building equipment or controls manufacturers; subsidiaries of electricity or gas utilities; those owned by other types of energy producer; and independents. In 2000, thirteen companies accounted for approximately 75% of total industrial activity.

Table 3.1 Market shares of different types of ESCO in the US (2000)

Company type	**Number of companies**	**Percentage of revenues**
Building equipment/controls manufactures	8	27
Utility subsidiaries	19	39
Other energy companies	3	24
Independents	24	10

Source: Goldman *et al* (2005)

A notable feature of the US market is the concentration of activity in public sector buildings (e.g. schools, hospitals, universities public housing). Table 3.2 shows that these sectors accounted for 73% of the total number of projects recorded in a database maintained by the US National Association of Energy Service Companies (NAESCO) (Goldman, Hopper et al., 2005).[8] This preference for the public sector has several origins. First, these facilities tend to be large, so the cost savings from energy efficiency projects are sufficient to offset the transaction costs of contracting. Second, these facilities are often old and in need of refurbishment, thereby providing significant technical opportunities for improved energy efficiency. Third, public sector organisations face fewer business risks, which reduces the cost of capital, encourages longer term contracts and thereby allows investment in projects with lower rates of return.[9] Finally, and most importantly, enabling legislation by state and federal governments has directly encouraged energy service contracting (Box 3.1), leading to a concentration of activity in those states where the design and implementation of legislation is most favourable.

[8] Goldman *et al* (2005) found 771 projects in the public sector with a total project cost of $1677 billion. In contrast, there were only 309 projects in the private sector with a total project cost of $260 billion.

[9] The private sector projects in Goldman *et al's* survey had a median payback of three years, compared to six years in the public sector.

One recent trend in the US market is the emergence of total energy management, often combined with the transfer of ownership of the relevant assets (Rufo, 2001). Here, the ESCO purchases, owns, operates and maintains the bulk of the energy infrastructure inside a facility, including boilers and CHP, heat and electricity distribution systems, lighting, compressed air and so on. Enron Energy Services developed this approach with a series of major outsourcing contracts in 2000 and 2001, but the idea has survived the collapse of Enron and has since been taken up by other companies such as Duke Solutions and TXU Energy Services.

Table 3.2 Shares of different end-use sectors in the US energy services market – results from a survey

Sector	**Subsector**	**Percent of projects**
Public	Schools	30
	State/local government	14
	Universities/colleges	9
	Federal government	6
	Health	12
	Public housing	3
	Subtotal	*74*
Private	Hotel/hospitality	2
	Office/commercial	10
	Retail	4
	Industrial	7
	Residential	1
	Other	2
	Subtotal	*26*

Source: Goldman, Hopper et al (2005)
Note: Based upon an analysis of the projects in a database maintained by the National Association of Energy Service Companies (NAESCO).

Box 3.1 Legislation encouraging energy service contracting in the US

- *DSM/IRP programmes*: Energy service companies have benefited directly from DSM/IRP programmes, through obtaining standardised contracts to deliver verified energy savings in return for incentive payments. They have also benefited indirectly, for example by using the incentives offered by utilities in their marketing activities. Funding for these programmes peaked in 1994 and has reduced considerably since then.
- *State performance contracting*: Many states have introduced legislation to encourage public sector institutions to enter into long-term energy service contracts. For example, these allow procurement decisions to be made on the basis of whole life costs, rather than minimising capital cost. The variation in ESCO activity between states is strongly correlated with the incentives provided by this legislation.
- *Federal performance contracting:* The Energy Policy Act of 1992 required federal agencies to pursue cost-effective energy efficiency investments. A favoured mechanism is the use of energy service contracts for periods of up to 25 years. This allows federal agencies to obtain private sector funding for capital improvements, without requiring congressional approval. Between 1988 and 2002, the federal agencies signed energy service contracts for $1.2 billion in energy efficiency investment.

Source: Goldman, Hopper *et al* (2005)

3.2 European experience with energy service contracts

Energy service contracting has been slower to develop in Europe and the market differs in a number of important respects from that in the US. A recent survey by the Joint Research Centre of the European Commission showed that the market was well established in the UK, Germany, Austria, Hungary and (to a lesser extent) France, but still in its infancy in most other European countries (Bertoldi and Rezessy, 2005).[10] The survey also found major differences between European countries in terms of the focus of ESCO activities (e.g. public sector versus private sector), the size and nature of the projects undertaken, the contractual terms employed, the methods of financing and the extent and nature of government support. A variety of factors explain these differences, although difficulties in financing energy efficiency projects are a prominent issue.

While the European energy services industry has benefited from DSM programmes by energy utilities, these have not played as important a role as in the US. Moreover, the liberalisation of gas and electricity markets is now well advanced throughout the EU, with a target of all customers being able to choose their energy supplier by 1st July 2007. As in the US, this has reduced DSM activity but also encouraged energy companies to develop energy service offerings as a means both to retain existing consumers and attract new ones (Chesshire, 2000). But unlike their US counterparts, European utilities have been relatively slow to acquire ESCOs, and the link between the service and commodity markets has been established instead by non-utility ESCOs who are increasingly assuming responsibility for energy purchasing. The most noticeable effect of liberalisation prior to 2003 has been the downward pressure on gas and electricity prices, combined with increased price volatility – both of which have a negative influence on energy service contracting. However, the recent upward trend in gas and electricity prices has encouraged renewed attention to energy efficiency.

An increasingly important driver for energy service contracting in the EU is climate policy, including most recently the EU Emissions Trading Scheme. In all EU countries, carbon trading coexists with a variety of more targeted initiatives on energy efficiency, including tax rebates, information and demonstration schemes and obligations on suppliers and distributors to encourage energy savings - including the introduction of 'white certificate' schemes in the UK, France and Italy (Harrison, Klevnas et al., 2005, ; Pavan, 2005). Both carbon credits/allowances and white certificates can provide an additional value stream for energy service contracts, and the Italian scheme has attracted considerable interest from ESCOs.

The European Commission has introduced a number of initiatives to promote the energy services industry, but these appear to have been relatively ineffective (Box 3.2). The main drivers for market growth appear to be autonomous factors such as increasing recognition of the economic benefits of energy service contracting, combined with the general trend towards outsourcing non-core activities. National and EU climate policy has provided an additional stimulus, as has financial and promotional support from regional and national energy agencies in Austria, Germany and Spain (Bertoldi and Rezessy, 2005). Concern over the impact of market liberalisation on energy efficiency has led the Commission to propose a new Directive on energy efficiency and energy services (COM (2003) 739 final), which

[10] Bertoldi and Rezessey (2005) put the UK, Germany, Austria, Hungary and France in the 'premier' league, and Spain, Sweden, the Czech Republic and Italy in the 'second' league. ESCO activity in other European countries appears to be minimal.

includes a rather vague requirement to remove barriers to energy service contracting and third-party financing. By itself, this appears unlikely to have any greater impact than the earlier initiatives, but the proposed target of a 1%/year improvement in aggregate energy efficiency (and 1.5%/year in the public sector) may have more far-reaching consequences.

Box 3.2 Initiatives by the European Commission to encourage energy service contracting

- *1988*: Recommendation to Member States to promote ESCOs and the use of Third Party Financing,
- *1993*: Directive (93/76/EC) on energy efficiency which (among other things) required Member States to implement programmes to encourage third-party financing for energy efficiency investments in the public sector.
- *1993 onwards*: Research activities and pilot/demonstration projects under the THERMIE and SAVE programmes.
- *1996*: Publication of standard energy service contracts (for industry and public buildings) in all the languages of the EU.
- *2002:* GreenLight programme to encourage energy efficient lighting, including a preliminary list of ESCOs.
- *2003*: Survey of ESCOs in the EU by the European Commission Joint Research Centre and development of an on-line database.
- *2004*: Proposed Directive on energy efficiency and energy services.

Recent survey work by Bertoldi and Rezessy (2005) has provided a valuable overview of the energy service industry in Europe. Table 3.3 shows that approximately half the ESCOs in the survey are independent specialist companies, while another quarter are owned by equipment manufacturers and suppliers. Public sector agencies are only active in a small number of Member States, while the market is highly concentrated in others. The most active companies are subsidiaries of large multinationals.

One interesting finding of this survey is that many European ESCOs (particularly in France, Italy and Germany) finance projects primarily through their own working capital, with debt financing only being employed more recently. This is in contrast with the US situation, where 86% of performance contracts in the NAESCO database were financed through debt taken on by the client (Goldman, Hopper et al., 2005). The UK is an important exception in this regard, with extensive use of debt financing.

Table 3.3 Overview of ESCOs in the EU (2005)

Category of organisation	**No. of companies**	**Percentage of total**
Independent specialist companies	65	47.4
Equipment manufacturers and suppliers	32	23.4
Energy utility or supply company	18	13.1
Public-private joint venture	9	6.6
Public sector agency	8	5.8
Finance institutions	1	0.7
Other	4	2.9
Total	*137*	*100.0*

Source: (Bertoldi and Rezessy, 2005)

It is difficult to assess the overall size of the EU energy services market, since observers and practitioners in different countries use different definitions. For example, Bertoldi *et al* (2005) report more than 70,000 energy service contracts in Germany, provided by 450 ESCOs with a annual turnover of €3 billion. In practice, many of these contracts would not qualify as energy service contracts according to the definition given in Section 2, and most of the ESCOs would be more accurately classified as ESPCs. The number of comprehensive performance contracts in Germany, as opposed to those within narrower scope such as heat supply, is estimated to be no more than 200 (Bertoldi, Rezessy et al., 2005, p. 35).

This highlights an important point. While documentary accounts of the US market for energy service contracting focus primarily on performance contracts, accounts of the European market use a broader definition, which includes supply contracting in general and the provision of CHP in particular. Supply contracts account for the bulk of the energy services market in most European countries, with performance contracting being a more recent innovation. Since performance contracting is rarely quantified as a distinctive category in the European literature, and since the broader market for energy service contracting is rarely quantified in the US literature, it is difficult to assess the relative size of the two markets. However, it appears likely that energy service contracting has contributed much less to the improvement of *end-use* efficiency in the EU than it has in the US. The further development of performance contracting in the EU therefore remains a key policy issue.

The results from the Bertoldi and Rezessy survey confirm the bias towards supply contracts in the EU, with more than half of the recorded projects being for heat supply and CHP (Bertoldi, Rezessy et al., 2005). Contracts for the industrial sector outnumbered those for the public sector (again, in contrast to the US) and the majority of contracts were between 5 and 15 years in duration.

3.3 UK experience with energy service contracts[11]

3.3.1 Origins of the UK market for energy service contracts

The UK market for energy service contracting could be said to have begun in 1984 when Shell launched Emstar (later AHS Emstar), as an 'energy management' company. BP followed shortly afterwards with BP Energy, which used a very similar business model focused on large sites in the industrial sector. While both companies engaged in a range of activities, the primary focus was heat supply (or 'heat service') contracts, a relatively low risk approach that included the provision of finance for fuel switching. This early model has proved highly influential, and supply contracts dominate the UK energy service market to this day.

A number of engineering companies followed the Emstar lead by offering finance and other 'value-added' services, but few came close to providing comprehensive performance contracts and the early market growth was rather less than expected. (Hansen and Weisman, 1998, p. 221). Most contracts were with the private sector, since Treasury rules created an obstacle to the use of private finance within the public sector. These so-called 'Ryrie rules' were removed in 1992 and replaced with the Private Finance Initiative (PFI), which has

[11] The information in this section is derived from trade journals, company websites and interviews with UK ESCOs, trade associations and market analysts.

become an increasingly important mechanism for the provision of public sector assets and infrastructure (Grout, 1997). While both the PFI and the broader trend towards contracting out non-core services are congruent with the philosophy of energy service contracting, the UK market is still biased towards the private sector.

The energy services market grew steadily during the 1990s, helped by the trend towards 'downsizing' and the increased use of outsourcing in industry. Gas and electricity market liberalisation proved to be an obstacle, however, as declining energy prices lead to clients losing interest in energy efficiency and focusing instead on improved energy purchasing. This trend has now reversed, and the large increases in gas and electricity prices since 2003 have coincided with tightening environmental regulations and a shortage of skilled energy management staff. This has proved a boost to the contracting market, which is currently growing at around 15%/year.

In 1998, AHS Emstar was taken over by Dalkia, a French multinational that was operating a similar 'heat service' model in France under the title 'chauffage'. While the market is now substantially larger and more differentiated that in the 1980's, Dalkia remains the market leader.

3.3.2 UK suppliers of energy service contracts

Energy service contracting is traditionally referred to as Contract Energy Management (CEM) in the UK, although different companies use different definitions of this term. Most UK CEM companies are members of the Contract Energy Management Group of the Energy Systems Trade Association (ESTA), which is itself an umbrella association for a broader group of companies offering a wider range of energy-related services.[12] The 13 Members of the CEM Group provide a variety of services to clients, but not all of these services meet the definition of energy service contracting proposed in Section 2. Furthermore, some important providers of energy service contracting (e.g. RWE Solutions) are not members of ESTA.

The numerous overlaps in the UK market are illustrated in Figure 3.1. There are companies offering energy service contracting that fall into each of the categories represented by the outer circles, as well as those that fall into none. The main providers are as follows:

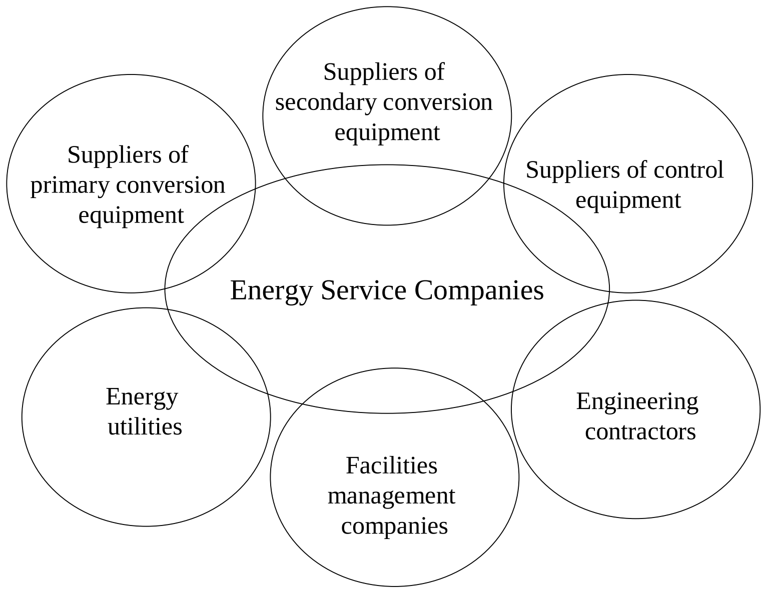
- *Suppliers of primary conversion equipment:* Some companies that are primarily boiler suppliers offer energy service contracts, although most of these contracts are on a turnkey basis. In addition, there are approximately 30 companies supplying and installing CHP plant, predominantly through long-term, energy service contracts. These installations range from small-scale package CHP to large-scale, multi-unit gas turbines, sized primarily for electricity export. CHP suppliers are represented in the UK by the Combined Heat Power Association (CHPA), which operates independently of ESTA and has a somewhat higher political profile. The CHPA is concerned with promoting the growth of CHP specifically, rather than energy service contracting more broadly.
- *Suppliers of secondary conversion equipment:* A number of vendors of secondary conversion equipment offer value-added services that amount to an energy services contract. For example, E.ON Ultra Air offers contracts for compressed air services, including design, installation, finance, operation and maintenance. Supply is priced in

[12] ESTA also has groups on energy consulting, lighting controls, metering and monitoring, energy-efficient drives and building controls.

€/m^3, declining with volume, with electricity costs paid for separately. These contracts are limited to a particular type and brand of equipment, but offer some potential for improving the energy efficiency of key energy services, particularly within the industrial market.

- *Suppliers of control equipment*: Both Honeywell and Johnson Controls are active in the UK building services market and offer a range of services, including US-style performance contracts. However, such contracts form a smaller proportion of these companies' activities in the UK than they do in the US.
- *Engineering contractors*: These companies offer both project engineering and contract maintenance services for a wide range of industrial and building services equipment, including heating, ventilation, air conditioning, refrigeration, water treatment and dedicated industrial processes. Many specialise in individual sectors and/or technologies and have a competitive advantage in those areas. Several companies that market themselves primarily as ESCOs (e.g. Dalkia) also offer shorter-term contract maintenance and other services, while others that market themselves primarily as engineering contractors (e.g. Lorne Stewart) also offer energy service contracts. Hence, the overlap of activities in this area is particularly blurred.
- *Facilities management companies:* A small number of companies (e.g. George S. Hall) offer energy service contracts as part of wider facilities management (FM) activities, including telecommunications, security, cleaning and grounds maintenance. The inclusion of energy services tends to be the exception rather than the rule, however, since most FM companies do not have the appropriate technical skills. Collaborations between ESCOs and FM companies also appear to be rare, despite the apparent synergies
- *Energy utilities*: A couple of UK ESCOs are subsidiaries of energy utilities, while others (e.g. RWE Solutions, Dalkia) are owned by a parent company that also owns energy and water companies. This allows them to combine energy service contracts with supply contracts for electricity, gas and/or water. Several energy suppliers entered the contracting market during the 1990s, but most of these ventures were short-lived.

Figure 3.1 Overlaps in the UK market for energy service contracts



The multiple overlaps illustrated in Figure 3.1 make it difficult to define the size and boundaries of the UK market for energy services contracting. A range of companies offer energy service contracts under a number of different headings, frequently using terminology that is unique to their firm.[13] Most of these companies provide energy service contracting alongside other types of services and in many cases it forms only a small part of their business. Many of the companies providing energy service contracts do not describe themselves as ESCOs, several are not members of ESTA and most are members of several different trade associations. The CHP segment of the market has attracted particular attention, but while the fortunes of CHP have varied over the last decade these are not necessarily correlated with the fortunes of the broader market for energy service contracts.[14] Potential clients are therefore confronted with a highly differentiated market, comprising companies selling a variety of non-standard ‘products’ without a commonly agreed system of classification.

3.3.3 Companies, activities and overall market size

The UK market is dominated by supply contracting and biased towards the private sector - although hospitals have proved to be a promising market for CHP and several community-

[13] For example, United Utilities distinguishes between: Energy Saving Partnerships aimed at smaller organisations; Energy Saving Performance contracts, aimed at larger organisations (typically with investment costs of £1-5 million); and the establishment of dedicated Energy Service Companies, or Community Energy Service Companies, which are joint ventures established to deliver very large-scale projects (>£5 million investment) to local authorities and urban regeneration companies.

[14] The primary driver of the CHP market is the differential between gas prices and the price for imported electricity (the ‘spark spread’), while the primary driver of the contracting market is the overall level of energy prices. While CHP is a subject of a specific government target (10GW of installed capacity by 2010), with corresponding political attention, the contracting market is viewed simply as one of several delivery mechanisms for achieving government targets on energy efficiency and carbon emissions.

heating schemes have been established with the help of grant funding from DEFRA (IPA Energy Consulting and e^{2}S, 2003).

Table 3.4 lists the 14 major companies that are active in the UK market and indicates their market share and focus of activities. There are four main competitors for supply contracts in the industrial market (Dalkia Utilities Services, Elyo Industrial, MCL Energy and RWE Solutions), and three main competitors for performance contracts in the public and commercial buildings market (Dalkia Energy and Technical Services, Cofatec Heatsave and United Utilities) These two groups of companies rarely compete with each other, while the market share of the other companies remains relatively small. Dalkia holds a dominant position in both markets, and is the market leader. However, while some companies (e.g. Lorne Stewart) have a relatively small share of the market for energy service contracts, they have a much large share of related markets such as contract maintenance.

Partly as a consequence of definitional problems, there are no accurate figures for the overall size of the UK market. In addition to the problem of defining what is or isn't an energy service contract, there is the additional problem of measuring the size of each contract. For example, should this be in terms of the annual revenue received by the ESCO, the capital value of new investment, or the size of the annual energy bill under contract (which may be less than the overall annual energy bill for these clients)?[15]

Most UK ESCOs indicate their turnover by the annual energy bills they handle. On this basis, ESTA estimated the market size in 2001 to be approximately £500 million/year, compared to only £127 million/year in 1993. This implies an annual growth rate of around 18% over this eight year period. In comparison, the total annual gas and electricity expenditure for the UK industrial, commercial and public sector combined was approximately £10 billion in 2000 (£8 billion electricity, £2 billion gas) (DTI, 2001). Ignoring coal and oil, this implies that ESCOs had captured approximately 5% of the target market – although some of the larger energy service contracts were for community heating projects in the residential sector. Since the energy service market is strongly oriented towards heat supply, the share of the UK gas market taken by energy service companies is likely to be higher. Furthermore, the ESTA figures derive from a survey of members and therefore exclude activities by non-members.

[15] Bertoldi and Rezessey (2005, p. 48) suggest as a rule of thumb that the capital value of new investment is broadly equivalent to the annual energy bill under contract. If so, these two measures will be similar in size.

Table 3.4 Overview of energy service contractors in the UK

Company	Share of UK CEM market	Sector focus	Contract types	PFI contracts?	ESTA member?	Comments
Dalkia Utilities Services	Large (market leader)	All, but predominantly large industrial and hospitals	Predominantly supply contracts, including CHP and multi-utilities	Many	Yes	Established as Emstar (later AHS) in 1984. Took over by Dalkia in 1994. Pioneered CEM in the UK and holds dominant position in UK market
Elyo Industrial	Large	Mainly large industrial. Some community heating.	Predominantly supply contracts, including CHP and multi-utilities	Some	Yes	Took over BP Energy and inherited contract portfolio. Main competitor to Dalkia.
United Utilities	Large (>200 contracts)	All, but predominantly public sector	Wide range, including comprehensive performance contracts and establishment of SPVs	Many	Yes	Business ranges from grant funded contracts with SMEs, to dedicated SPVs for multi-utility services & community heating for local authority housing.
Cofathec Heatsave Limited	Large (>1000 contracts, but many O&M only)	Commercial offices	Performance and supply contracts, mostly confined to space heating and building controls.	Few	Yes	Business developed from O&M contracts for heating systems
MCL Energy	Medium (~100 contracts)	All	Predominantly heat supply, but including 5 CHP.	Some	Yes	Competitor to Dalkia and Elyo. Supply contracts often include end-use efficiency, and only half involve new investment.
RWE Solutions	Medium (15 UK contracts, 6 large)	Industrial	From heat supply to total energy management	None	No	Subsidiary of large multinational. Links with energy and water utilities that are also owned by RWE
Dalkia Energy & Technical Services	Small	Public and commercial buildings	Performance contracts. Also consulting, facilities management etc.	Few	Yes	
Johnson Control Systems Limited (CEM)	Small (3 performance contracts)	Public and commercial buildings	Performance contracts. Also energy purchasing, facilities management etc.	Few	Yes	UK division has relatively few performance contracts. Most contracts are energy purchasing and/or O&M and/or facilities management

Energy Services (UK)	Medium	All	Predominantly supply contracts, including CHP	Yes	Yes	Offers portfolio of services including mechanical and electrical contracting
Inenco Group Limited	Small	Industrial	Performance contracts, multi-utility. Also energy purchasing, energy auditing, project management etc.	No	Yes	Performance contracts form only a small part of the business. Majority is for consulting,, project engineering etc.
Lorne Stewart Services	Small	Public and commercial buildings	Performance contracts, multi-utility	Yes	Yes	Performance contracts form only a small part of the business. Majority is for mechanical and electrical contracting
Parkersell Services	Small	All	Performance contracts primarily for lighting	?	Yes	Part of Dalkia Group. Performance contracts add value to installation and maintenance contracts for lighting systems
E.ON ENERGY	Small	All	Supply contracts, particularly large scale CHP			Formerly Powergen. Large commodity supplier with CHP business
George S. Hall	Small	Public and commercial buildings	Facilities management contracts	No	No	International facilities management company, increasingly specialising in energy management

3.3.4 Scope and depth of UK contracts

Supply contracts are the dominant model in UK industry, but are also used in universities, hospitals and other sectors. Performance contracts are less common and are mostly used for commercial buildings - frequently under the umbrella of a multi-site contract. Both types of contract are predominantly focused upon heat rather than electricity.

The traditional ‘heat service’ model involves the contractor ‘taking over the boiler-house’ and selling hot water or steam to the client. Such contracts include replacement, retrofit or refurbishment of boilers, improved heat distribution systems and operation and maintenance of equipment. Performance guarantees relate to thermal efficiency, steam/water quality and plant availability, but heat prices are usually indexed to fuel prices. On large industrial sites, these contracts increasingly extend to include water supply and effluent disposal as well as other utilities. Electronic controls are standard and contracts frequently include investment in Building Management Systems for heating (not lighting). Direct involvement in industrial processes is rare, and many contractors characterise their service as ‘up to the first process valve’.[16] Approximately one half of contracts involve the contractor taking over responsibility for energy purchasing.

Investment in CHP is in many ways an extension of the basic heat service contract, although it brings an additional set of complications. CHP requires long-term contracts and a stable heat load, which implies a take-or-pay contract for the heat, and possibly for electricity as well. Larger plant may be sized for electricity export, but this is rarely economic for small and medium sized plant and has arguably been discouraged by the New Electricity Trading Arrangements (NETA) (House of Commons, 2003). CHP has suffered mixed fortunes over the past few years, but recent trends in electricity prices, combined with carbon pricing through the EU ETS, may act in its favour.

It is relatively uncommon for supply contracts to include improvements in the efficiency of electricity use. Services such as lighting and motive power are either excluded altogether from such contracts, or included as ‘add-ons’. The reason appears to be the relative lack of control the contractor has over in electricity demand. At the same time, the traditional heat service contract may be losing favour, as clients become more sophisticated and seek further ways to reduce energy costs. Enron showed a possible way forward with the introduction of a total energy management contract for a large UK brewery that included transfer of asset ownership. This contract has been taken over by RWE following Enron’s demise, but few other contractors appear to be following this model.

The market for performance contracts also focuses primarily on heating systems and has evolved as a way of adding value to traditional equipment maintenance or energy procurement contracts. The terms ‘guaranteed savings’ and ‘shared savings’ are employed, but not consistently by all contractors and not always in the same way as in the US - in particular, the link between these terms and the source of finance is not always made. The most common type of guaranteed savings contract is the ‘fixed fee’ contract, in which the client is guaranteed a fixed price for heating regardless of fuel price trends. These appear to have lost popularity as clients realised they were not getting the benefits of the large

[16] Examples of outsourcing infra-red drying and heat recovery boilers were provided by interviewees, but these appear to be exceptional.

reductions in gas prices that occurred during the 1990s. Hence, some form of shared savings is now the norm.

Some of the largest performance contracts are for multiple sites owned by retailers or commercial businesses and linked to energy purchase contracts. Long-term contracts appear to be more difficult to establish for private sector companies, partly as a consequence of business risk. Marketing CEM to private sector clients can also be difficult, since energy costs often form a small proportion of total costs and hence are frequently overlooked. A common strategy is to expand the scope of a contract over time, building upon existing maintenance contracts or upon the contractor's earlier success in reducing energy costs.

As with supply contracts, the primary reason for excluding end-uses of electricity (including lighting) from performance contracts appears to be the difficulty in obtaining sufficient control over electricity demand. The result, however, is that a potentially very large source of cost savings is excluded.

3.3.5 Source of finance and contract terms

Sources of finance for energy service contracts are mixed. Companies such as Dalkia, United Utilities and RWE are subsidiaries of large multinationals and have access to substantial in-house capital that can be used to finance all but the largest projects. Other companies rely more on clients taking on debt, although this can be a problem if clients have a high credit risk or seek off-balance sheet financing. Large CHP projects are frequently delivered through a joint-venture company, an approach that appears to be more common in the UK than in other European countries (Bertoldi and Rezessy, 2005). In general, and in contrast to other Member States, access to finance does not seem to be a major barrier for the majority of private sector contracts in the UK.

The monitoring and verification of energy cost savings commands much less attention in the UK than it does in the US. No UK companies are using the IPMVP and many ESCO employees appear to be unaware of its existence. This may largely be explained by the dominance of supply contracts in the UK, where detailed procedures for monitoring and verification are much less appropriate. However, several companies reported that their in-house methodologies for M&V in performance contracts were also relatively straightforward, suggesting that UK clients and contractors give a lower priority to this than their counterparts in the US. In practice, the role of M&V in 'proving' cost savings to the client or lender appears to be secondary to its role in providing information to the contractor, enabling them to optimise plant operation.

As elsewhere, a key issue for the UK market is the minimum size of client for which an energy service contract is viable. The possible saving in energy costs will depend upon the annual energy bill under contract, and since many contracts are confined to heat services, only the fuel bill may be relevant. For example, a site with an annual energy bill of £1 million may have an annual fuel bill of only £250k. However, the inclusion of CHP would make a large portion of the electricity bill relevant, while extension of the contract to include water supply and effluent would extend the bill further.

It appears that, at present, no UK contractor would consider an individual site with an annual energy bill less than £50k, and most would require > £100k. Contractors specialising in the industrial sector prefer to focus on large sites, with annual energy bills in excess of £0.5

million. Individual sites smaller than £50k/year may, however, be included in performance contracts as part of a multi-site contract with a single client. One contractor has provided services to SMEs with annual bills as small as £10k/year, but this has only been possible with the help of grant funding from Regional Development Agencies. The Energy Savings Trust has explored the possibility of extending energy service contracting to SMEs, but this does not appear to have led to any concrete outcomes

3.3.6 Drivers and barriers to UK contracts

Interviews with UK contractors and their clients suggest a complex mix of motivations and barriers to energy service contracting, the relative importance of which varies between different sectors and organisations. The primary motive for a client to enter into an energy services contract appears to be the cost savings that can be achieved, while the primary obstacle appears to be the difficulty of achieving those cost savings for particular sites and services, once the transaction costs of contracting are taken into account. But the determinants of these cost savings and transaction costs are varied, and decisions may not always be taken on a wholly rational basis.

Some of the most important drivers for establishing an energy service contract include:

- The need to replace or upgrade key items of energy-related equipment. This may be due to the age of plant, or to the deterioration of operational efficiency, reliability or quality of service, including the comfort of building occupants.
- The need to invest in new equipment, combined in many cases with a desire to avoid incurring additional debt on the balance sheet.
- The need to access expertise and skills that are not available in-house, perhaps as a consequence of downsizing or of the retirement of key personnel.
- The need to comply with health, safety and environmental regulations, particularly in view of the increasing complexity of such regulations.
- The desire to offload equipment performance and other risks to parties that are better able to manage them.
- The desire to concentrate attention on core competences, and to outsource non-core activities.
- The desire to demonstrate visible improvements in environmental performance and carbon emissions. This is primarily a concern of larger companies with a high public profile, who are sensitive to investor or consumer pressure.

There are also numerous barriers to the adoption of energy service contracts, many of which are analogous to the in-house barriers to improving energy efficiency (Sorrell, Schleich et al., 2004). These obstacles may be characterised from the clients' perspective as follows:

- *We've not heard of it*: Potential clients are frequently unaware of the nature of energy service contracting and of the opportunities it has to offer - despite the 25-year history of the model in the UK.[17]

[17] One interviewee commented: "...We were recently in discussions with the large company who were 'gobsmacked' that this sort of contract could be established. They had no idea! They had never heard of the concept. Our impression is that the message is not really getting through."

- *We don’t understand it*: Even when potential clients have heard of the concept, they may have only a limited understanding of what it involves.
- *We think there’s a catch*: Distrust of the ‘something for nothing’ nature of energy service contracting appears to be common.
- *We don't want to commit*: CHP projects require long-term contracts to be viable, as do many end-use efficiency projects. But many private sector clients face substantial uncertainty over their long-term business prospects and their long-term energy needs, making it difficult to undertake such commitments.
- *We can do it better:* Energy management staff in potential client organisations may be reluctant to share potential cost savings with a contractor and may prefer to implement the relevant projects themselves.[18] This may be the case, even when current performance is relatively poor and there is little chance of projects going ahead without external financing.
- *We are efficient already:* Senior management in potential client organisations are frequently unaware of the opportunities for cost saving through improved energy efficiency. This militates against energy service contracting, as much as it does in-house energy management.
- *We don’t want to lose control*: Industrial firms have an overriding concern with equipment reliability and continuity in production. This can lead to a preference for in-house control of energy systems and to having skilled people on-site, rather than relying on remote monitoring of utilities plant. Contractual guarantees of equipment reliability may not be considered an adequate safeguard.
- *We don’t have the time:* The combination of severe time constraints on key staff and the small contribution of energy to total costs in many sectors, leads naturally to a neglect of energy management. Since establishing an energy service contract also requires management time, it may also be avoided - despite its potential for freeing-up staff time over the longer term
- *We don’t know our own costs:* Many potential clients do not monitor energy consumption accurately and fail to account adequately for all energy-related costs. Hence, an energy service contract that properly accounts for all costs and correctly prices all risks may not seem attractive to the client, since the cost of the in-house alternative is incorrectly specified.
- *We don’t have the responsibility:* It is frequently the case the responsibility for energy decision-making is split between several departments within an organisation. In addition to their reluctance give up control, this creates difficulties for the ESCO in finding a suitable individual to deal with. This may be particularly the case in the public sector, where bureaucratic committee structures and time-consuming decision-making procedures can create an obstacle.
- *We don't want to lose our jobs*: Contractors may make cost savings by reducing staff numbers (particularly if new equipment requires less maintenance), or by changing the terms and conditions of employment for transferred staff. Fear of this creates opposition to outsourcing from unions and employees, particularly within the public sector. The UK government has introduced legislation to protect employees in these circumstances (DTI, 2002).

[18] One client commented: “……I’m suspicious of ESCOs. They take away some of my interest and make a killing on it. If a company gives away its service centre to an ESCO, it is saying that it is incapable of running its own boiler house. That is criminal, from an engineers point of view.”

- *We don't want to give away secrets*: Industrial companies may be concerned that confidential details of industrial processes could pass to competitors via the contractor. While this risk is likely to be overstated, it may be one reason for avoiding energy service contracts altogether, or confining them to energy supply.
- *We've heard that ESCOs rip you off:* There are a number of stories circulating within the UK generally and within certain sectors in particular, regarding bad experiences with energy service contracting. Whatever their validity, these stories appear to have a long shelf-life and may influence decision-making in some circumstances.
- *We want to move slowly*: Organisations may be understandably reluctant to move to a comprehensive energy service contract, without prior experience of the costs and benefits of such arrangements. Hence, many contractors have found that a step by step approach is effective, in which working arrangements and trust are built up over time, allowing the scope of the contract to be gradually extended.

3.3.7 Contracts in the UK public sector

Given that the UK has pioneered both the 'contracting-out' of non-core services and the use of Public Private Partnerships (PPPs) in the public sector, the limited number of energy service contracts in this sector appears surprising. Contracting-out is defined here as opening up to competition a set of activities that were previously protected from it (Domberger and Jensen, 1996), while PPPs are defined as the combination of contracting-out with the allocation of responsibilities (e.g. design, build, operation, maintenance) to a single consortium or partner, combined with the use of project-based, private sector financing (de Bettignies and Ross, 2004). PPPs have been encouraged through the Private Finance Initiative (PFI), which was first introduced in 1992 and has evolved over time to play an important role in the provision of public sector assets and infrastructure, such as hospitals, prisons and bridges (HOCL, 2003).

The rationale for the PFI has been variously defined as enabling projects to be undertaken which the public sector 'cannot afford' (owing to constraints on public borrowing) and obtaining value for money in the provision of public sector services through market incentives and risk transfer (Grout, 1997). The first rationale has been shown by number of authors to be seriously flawed (Heald and Geaughan, 1999, ; Robinson, Hawksworth et al., 2000), while the second rationale raises complex issues regarding the valuation of risk and the appropriate assessment of value for money (Grout, 1997). Box 3.3 summarises the government's current position.

Box 3.3 The UK government's view of the Private Finance Initiative

Under the Private Finance Initiative (PFI) the public sector contracts to purchase services on a long-term basis so as to take advantage of private sector management skills incentivised by having private finance at risk. The private sector has always been involved in the building and maintenance of public infrastructure, but PFI ensures that contractors are bound into long-term maintenance contracts and shoulder responsibility for the quality of the work they do. With PFI, the public sector defines what is required to meet public needs and ensures delivery of the outputs through the contract. Consequently, the private sector can be harnessed to deliver investment in better quality public services whilst frontline services are retained within the public sector.

The Government only uses PFI where it is appropriate and where it expects it to deliver value for money. This is based on an assessment of the lifetime costs of both providing and maintaining the underlying asset, and of the running costs of delivering the required level of service. In assessing where PFI is appropriate, the Government's approach is based on its commitment to efficiency, equity and accountability, and on the Prime Minister's principles of public service reform. PFI is only used where it can meet these requirements, and where the value for money it offers is not at the expense of the terms and conditions of staff. The Government is committed to securing the best value for its investment programme by ensuring that there is no inherent bias in favour of one procurement option over another.

Source: Extract from the Budget Speech 2005: Rt. Hon. Gordon Brown MP Chancellor of the Exchequer

Both contracting-out and energy service contracting use competitive bidding to provide services at lower cost than previously achieved in-house. The additional synergy between PPPs and energy service contracting results from the focus on outputs (service provision) rather than inputs, combined with the use of project financing of large-scale assets. The complexity of PFI arrangements confines its use to large scale projects, typically with an investment value greater than £10 million. As a result, the only stand-alone energy projects suitable for PPPs are likely to be large scale CHP and community heating projects. However, energy service contractors may participate alongside construction firms, M&E contractors and others in the provision of energy services for new building projects, such as hospitals and prisons.

While a number of public sector energy service contracts exist, the level of penetration appears below the market potential. While Dalkia has succeeded in becoming a regular participant in public sector bids, most contractors treat the process with great caution. The primary reason is the very high cost of bidding for a contract, combined with the high risk of failure. As an illustration, a study by the Adam Smith Institute found that PFI tendering costs for the successful bidder averaged around 0.5% of total project costs, while tendering costs of all potential contractors were just under 3% of project costs (Latham, 1994). These costs were much greater than for other procurement methods and tended to increase in percentage terms with project size. As an illustration, with six bidders for a £20 million contact, this translates to tender costs for each of £100k. Many contractors would consider this to be excessive.

Related concerns regarding the PFI process relate to the time taken to complete PFI deals, the difficulty in establishing 'best value' in procurement which (despite best intentions) can lead to a bias towards minimising capital cost, and the limitations of the competitive tendering process itself, which can prevent appropriate solutions from being developed in 'partnership' with the client. The government has taken steps to simplify and standardise PFI contracts and bidding procedures and to promote energy service contracts through the PFI approach (DoE, 1996). But to date, these initiatives do not appear to have had the desired effect.

3.4 Summary

This section has summarised the origin and status of energy service contracting in the US and Europe and described the size, nature and operation of the UK market in more detail. Since quantitative data is sparse, the treatment has necessarily been somewhat impressionistic.

The US and UK market share and number of common features, including the range and complexity of the 'products' on offer, the diversity of companies providing energy services (and the consequent difficulties in establishing market boundaries) and the strong market growth. At the same time, there are number of important differences. While the US market is dominated by performance contracting in the public sector, the UK market is dominated by supply contracting in the private sector. Similarly, while client financing dominates in the US (partly as a consequence of the tax breaks available for public sector institutions), the methods of financing in the UK are more mixed and include a larger contribution from contractors themselves. The UK market is relatively large compared to most European countries, but comparison with the US suggests scope for further expansion - particularly within public sector buildings.

These differences are important for two reasons. First, most of the literature on energy service contracting is from US sources and uses terms (e.g. guaranteed savings versus shared savings) and ideas (e.g. the relative advantage of guaranteed savings) that may be less appropriate in other contexts. Second, since the underlying economics of energy service contract should be broadly similar on both sides of the Atlantic, the differing size and focus of the two markets requires some explanation. This points to the importance of institutional issues such as availability of finance, public sector procurement rules, tax rules and the degree of policy encouragement of energy service contracts. These will be explored further in the next section, in the context of a broader model of the economics of such contracts.

4 The economics of energy service contracting

4.1 The economics of outsourcing

While the literature on energy service contracting provides some valuable insights into costs, risks, contractual forms, financing and other relevant issues, it generally lacks a formal theoretical framework. Furthermore, while this literature comments on the suitability of different activities for contracting and the relative importance of different types of barrier, these propositions have not been subject to formal tests.

This weakness is surprising given the wealth of economic literature on ‘outsourcing’ - defined here as the use of external agents to carry out one or more recurring organisational activities that were previously conducted in-house. An energy service contract is merely a specialised form of outsourcing and has much in common with other outsourcing contracts, such as those for security, buildings maintenance, telecommunications and information technology. All of these have experienced substantial market growth since the late 1980s and the last in particular has become a multi-billion dollar industry. There is now a wealth of academic literature on the economics of such arrangements, including theoretical models, detailed case studies and large-scale surveys incorporating statistical tests of hypotheses. These provide an accumulating body of theory and evidence that is highly relevant to the energy service market.

The primary research question within the outsourcing literature is:

What explains an organisation’s decision to outsource (or not to outsource) a particular activity or service?

This variant of the ‘make or buy’ decision has been extensively explored for a variety of activities and services in a number of sectors and countries (Reindfleisch and Heide, 1997). Proposed explanations focus primarily on the nature of the individual activity or service, but they also take into account the nature of the relevant organisation (e.g. its size) and the market and/or institutional context in which it operates. Most studies utilise a theoretical framework known as **Transaction Cost Economics (TCE),** which was originally developed by Williamson (1985) and has been extensively validated through empirical research (Shelanski and Klein, 1995). TCE provides a powerful set of ideas with which to understand and explain organisational arrangements in general and the outsourcing relationship in particular.

A second question in the outsourcing literature is:

What explains the terms of an outsourcing contract and the nature of a client’s relationship with its contractor?

This relates in particular to the choice between detailed and formal contractual provisions on the one hand, and more informal trust-based relationships on the other. Researchers have examined the choice and effectiveness of these two approaches in different situations and have asked whether they should be considered as substitutes or complements (Meer-Kooistra and Vosselman, 2000, ; Poppo and Zenger, 2002, ; Barthelemy, 2003). In these studies, the TCE framework is frequently supplemented with sociological ideas, that emphasise the importance of trust in inter-organisational relationships (Chiles and McMackin, 1996, ; Burchell and Wilkinson, 1997, ; Lyons and Mehta, 1997).

The third question commonly asked in the outsourcing literature is:

What explains the relative success of an outsourcing contract?

'Success' here relates primarily to the cost savings achieved, but also to associated factors such as the quality and reliability of the service and the responsiveness of the contractor to problems. While cost savings can sometimes be quantified, empirical research frequently relies upon the perceptions of success by the client (Wang, 2002). The theoretical framework is again primarily derived from TCE.

Taken together, the three questions cover the decision to use outsourcing, the process by which it is organised and the ultimate outcome of the outsourcing decision. But while the dependent variables are different in each case, the independent variables and explanatory models are very similar and are largely derived from TCE.

For our purposes, the most important question is the first: what explains the decision to outsource a particular useful energy stream or final energy service? Improved understanding of this could help clients identify those streams or/services that are more or less suitable for contracting, help analysts assess the market potential for energy service contracting, and help policymakers decide whether and how to encourage energy service contracting. The second question is primarily of interest to clients and contractors in designing an energy service contract and managing the contracting relationship. But improved understanding of this may help explain recent trends in the energy service market, including the increased use of 'partnering' arrangements (Mollerston and Sandber, 2004). The third question follows logically from the first two: successful contracts are likely to be those which are well-designed and managed and for which the choice of services and systems is appropriate.

The following sections develop a theoretical model of energy service contracting that allows each of the above questions to be addressed. The model draws upon ideas and results from several studies in the TCE literature, including in particular the framework proposed by Globerman and Vining (1996). The basic assumption is that a client will only outsource energy services when the expected reduction in the *production cost* of supplying those services can more than offset the expected *transaction cost* of negotiating and managing the relationship with the energy service contractor. This framework leads to a number of hypotheses that are suitable for empirical test. An approach to conducting such tests is briefly outlined in Section 4.5.5.

4.2 The condition for a viable energy service contract

4.2.1 Production, transaction and total costs

It is proposed here that the primary motive for contracting is to reduce the **total** cost of supplying a particular useful energy stream or final energy service, while maintaining adequate standards of service quality and reliability. It was suggested in section 3.3.6 that individual clients may have a range of motivations for entering into an energy service contract, but the majority of these can be properly be incorporated within a standard cost-benefit framework.

The total cost of supplying a particular useful stream or service may be subdivided into:

- *production costs*, which comprise the expenditures for inputs, such as fuel and electricity; and
- *transaction costs*, which comprise the costs associated with organising (or ‘governing’) the production of energy services (Globerman and Vining, 1996).

Production costs are familiar to practitioners and can be measured relatively easily. They include:

- the capital costs of any replacement conversion, distribution and control equipment, including the financing costs of any associated debt;
- the operation and maintenance costs of this equipment, including staff and materials; and
- the purchase cost of the relevant energy commodities, such as fuel and electricity.

The last will depend upon the technical and operational efficiency of the relevant equipment and the demand for the relevant energy streams or services. When an energy service is provided in-house, the client will incur production costs in the form of payments to in-house staff, as well as to third parties such as energy suppliers, equipment suppliers and maintenance contractors. When a service is provided through an outsourcing contract, the client will incur some of these costs directly and pay for the rest through the energy service contract. The split between the two will depend upon the contract depth. For example, maintenance costs will be paid for directly if the client retains responsibility for maintenance, or indirectly if maintenance tasks are outsourced to the contractor

Transaction costs may be less familiar to practitioners and are notoriously difficult to measure. In the case of an outsourcing contract, they will include the staff, consulting and legal costs associated with searching for a supplier, negotiating and writing the contract, monitoring contract performance, enforcing compliance, negotiating changes to the contract when unforeseen circumstances arise and resolving any disputes. They will also include the costs associated with opportunistic behaviour by either party, such as when a contractor fails to maintain equipment to an adequate standard (Williamson, 1985).

The nature of transaction costs is discussed further below. But a key point to note is that transaction costs are unavoidable - they are encountered universally within both markets and organisations as a consequence of the limitations of human decision-making (Furubotn and

Richter, 1997, p. 39). As a result, there will be transaction costs associated with the in-house provision of energy services, as much as with the provision of those services through an energy service contract.

There is good evidence that outsourcing can achieve substantial reductions in the production cost of supplying different types of service. For example, British, Australian and Canadian studies have found production cost savings in the range 20-30% from contracting-out services in the public sector (Kitchen, 1992, ; Domberger and Hall, 1996, ; Domberger and Jensen, 1996). In the case of energy services, the most comprehensive evidence derives from a survey of US performance contracts by Goldman *et al* (2005), who found a median benefit-cost ratio of 1.6 for public-sector contracts and 2.1 for private sector contracts. However, as with most attempts to quantify the benefits of outsourcing, the Goldman *et al* study largely neglected the transaction costs incurred by the client and contractor in establishing, operating and enforcing the energy services contract. This is important, as it is likely that the transaction costs associated with an outsourcing contract will be higher than those for in-house provision. In some circumstances, these additional transaction costs could outweigh any savings in production costs and hence make an energy service contract unviable.

4.2.2 Conditions for a viable contract

To illustrate this more formally, consider a potential energy service contract for a client, in which the scope (s) and depth (d) of the contract are fixed. Then let:

P_{CL} = Production costs incurred directly by client
P_{CON} = Production costs incurred by contractor
T_{CL} = Transaction costs incurred by client
T_{CON} = Transaction costs incurred by contractor
PAY = Payments to contractor
= Revenues from client

In addition, let the superscripts IN and OUT refer to in-house and outsourced provision respectively. Then, $P_{CL}^{IN} > 0$, $T_{CL}^{IN} > 0$, $P_{CON}^{IN} = 0$, $T_{CON}^{IN} = 0$, $P_{CL}^{OUT} > 0$, $T_{CL}^{OUT} > 0$, $P_{CON}^{OUT} > 0$, $T_{CON}^{OUT} > 0$.

For outsourcing to be attractive for the client, the following inequality must hold:

$$(P_{CL}^{IN} + T_{CL}^{IN}) \geq (P_{CL}^{OUT} + T_{CL}^{OUT} + PAY)$$

Rearranging:

$$PAY \leq (P_{CL}^{IN} - P_{CL}^{OUT}) + (T_{CL}^{IN} - T_{CL}^{OUT})$$

Hence, the first condition for a viable contract may be stated as:

the contract payments must be less than or equal to the total savings achieved by the client.

We would expect the first term on the right-hand side in the above equation to be positive: the client achieves a saving in production costs. Similar, we would expect the second term to be negative: the client incurs additional transaction costs.

For outsourcing to be attractive for the contractor, the following inequality must hold:

$$PAY \geq (P_{CON}^{OUT} + T_{CON}^{OUT})$$

Hence, the second condition for a viable contract may be stated as:

the contract revenues must be greater than or equal to the total costs incurred by the contractor

In practice, the contractor would need to make an acceptable return on investment, and would also need to recover marketing and other overhead costs not directly associated with the individual contract.

Combining the two equations gives:

$$(P_{CL}^{IN} - P_{CL}^{OUT}) - (T_{CL}^{OUT} - T_{CL}^{IN}) \geq PAY \geq (P_{CON}^{OUT} + T_{CON}^{OUT})$$

Contracting is only viable when both of these inequalities are satisfied. The savings for the client are maximised when the contractor is supplying energy services at cost. Then:

$$PAY = (P_{CON}^{OUT} + T_{CON}^{OUT})$$

Substituting:

$$(P_{CL}^{IN} - P_{CL}^{OUT}) - (T_{CL}^{OUT} - T_{CL}^{IN}) \geq (P_{CON}^{OUT} + T_{CON}^{OUT})$$

Rearranging:

$$P_{CL}^{IN} - (P_{CL}^{OUT} + P_{CON}^{OUT}) \geq (T_{CON}^{OUT} + T_{CL}^{OUT}) - T_{CL}^{IN}$$

Hence, the third condition for a viable contract is:

the total savings in production cost achieved through the contract must be greater than or equal to the total increase in transaction costs

The distribution of production cost savings between the contractor and the client will depend upon the choices made for contract terms (PAY). The client will seek to choose PAY so as to minimise contract payments, while the contractor will seek to choose PAY so as to maximise contract revenues. The choice made for PAY will influence the contractor's incentives to minimise production costs throughout the duration of the contract. These incentives will be maximised when contract revenues are independent of the production costs incurred by the contractor (P_{CON}^{OUT}), since the contractor will retain any savings in those costs.

The above conditions and expressions refer to a contract with a fixed scope and depth. But in practice, the client will seek to choose scope and depth so as to maximise cost savings, while the contractor will seek to choose scope and depth so as to maximise profits. The decision rules for whether to include an additional energy service within the scope of the contract, or an additional organisational activity within the depth of the contract, may be stated as follows:

- *Client:* the additional contract payments must be less than the additional savings achieved.
- *Contractor*: the additional contract revenues must exceed the additional costs incurred.

The condition for both of these to be possible is that the additional saving in production costs exceeds the additional increase in transaction costs, for the client and contractor combined.

The saving in production costs is the key to a successful energy services contract, and contractors will invest substantial time and money in conducting an on-site energy audit to estimate the size of the savings that can be achieved. Transaction costs (including those for the audit itself) are much more difficult to quantify, but their determinants are well established and should be taken into account by both the contractor and the client when making the outsourcing decision. Hence, the claim that a client will outsource energy services if it minimises the total costs of obtaining those services is perhaps better expressed as: 'a client will outsource energy services if it minimises its *estimated and anticipated* total costs at the time of making the decision' (Buckley and Chapman, 1997). Similar comments apply to the decision rules for the contractor.

The following sections examine the determinants of production and transaction costs in more detail, drawing in particular on the framework proposed by Globerman and Vining (1996).

4.3 Production costs and energy service contracts

4.3.1 The technical potential for reducing production costs

Each stream of useful energy at a site will have an associated in-house production cost, as will each energy service. These costs could be reduced through a combination of technical and organisational improvements, with the largest source of potential cost saving likely to be through reductions in energy demand. This may be achieved in three ways: a) reducing the demand for final energy services through improved control; b) improving the technical efficiency of conversion and distribution equipment through retrofit, refurbishment and/or replacement; and/or c) improving the operational efficiency of conversion and distribution equipment through better operation, maintenance and control.

The technical potential for each of these (e.g. the maximum thermal efficiency of boiler plant) will set a ceiling on the potential improvement in operational efficiency compared to the historical baseline. Multiplying this by the benchmark demand for each energy commodity gives the maximum achievable demand reduction (in kWh). Multiplying this by the benchmark unit price for each energy commodity gives the maximum achievable saving in energy purchase costs through demand reductions (in £k). Additional savings may be achieved by minimising: the purchase price for energy commodities; the staff and material cost for operation and maintenance; the purchase price of new equipment; and the cost of borrowing. The sum of these individual cost savings gives the technical potential for cost saving for each useful energy stream and final energy service at a particular site (in £k). The overall technical potential for cost saving at a site will equal the sum of these for all the relevant useful energy streams and final energy services at the site.

For an individual energy service contract, the technical potential for cost saving will depend upon the number of streams and services that are included - i.e. the scope of the contract. A smaller scope should reduce the technical potential, while a larger scope should increase it. But since some streams or services (e.g. heat supply) could offer greater potential for cost saving than others (e.g. motors), the relationship between contract scope and technical potential will not be linear.

Extending the contract to include other utilities such as water will increase the technical potential beyond that for energy alone. Similarly, including several sites within a multi-site contract will also increase the technical potential.

4.3.2 Why contracting can reduce production costs

While the technical potential will be largely determined by technical factors, the extent to which this is realised will depend upon the organisational arrangements for providing energy services. The advantage of contracting is that it can allow a greater proportion of the technical potential to be achieved than through the alternative of in-house provision. There are three main reasons for this (Globerman and Vining, 1996, p. 579):

- Energy service contractors can provide economies of scale in the provision of energy services.
- Competitive tendering can provide energy service contractors with an incentive to minimise bid costs.
- Performance incentives within the contract can provide energy service contractors with an ongoing incentive to minimise costs.

4.3.2.1 Economies of scale

For many clients, energy costs will be small in both absolute terms and as a proportion of total costs. As a result, many clients will lack the scale to manage energy efficiently and will face diseconomies of scope in attempting to manage multiple activities (Globerman and Vining, 1996, p. 579). For example, energy management may be allocated to a single, time-constrained facilities manager who combines inadequate skills, information and training with multiple and conflicting responsibilities (Sorrell, Schleich *et al.*, 2004). Staff in this position are unlikely to devote much time to energy efficiency, with the result that cost-effective opportunities may be routinely overlooked.

In contrast, contractors that specialise in energy management and contract with multiple clients should have the potential to achieve considerable economies of scale. The reasons include:

- *Specialised inputs:* Contractors can afford to employ specialised technical and managerial expertise in relevant areas, since each of these staff can serve a number of clients. Such staff should be able to develop and apply specialist skills (e.g. operating building management systems) that would not be feasible within the client organisation, as well as to rapidly disseminate learning benefits between different clients.

- *Lower input costs*: Contractors can purchase inputs in bulk and therefore take advantage of volume discounts. This applies in particular to energy commodities and to key items of energy conversion, distribution and control equipment. Contractors may also be able to provide, obtain or facilitate access to lower cost financing.
- *Standardisation and cost comparison:* Contractors can employ uniform monitoring, control and data administration procedures across several client sites - including remote monitoring of utilities plant. This can allow performance benchmarks to be established and ensure that deviations from expected performance are rapidly detected and analysed.

The scale economies provided by contracting should be proportional to the total energy costs under a contractor's control at a particular point in time, relative to the energy costs of the client. In contrast, the *learning* economies provided by contracting should be proportional to the cumulative energy costs that a contractor has assumed responsibility for over a period of time, relative to those of the client. Contractors may have an advantage in both of these relative to potential clients and this should enable them to achieve a greater proportion of the cost saving potential.

4.3.2.2 Competitive tendering

If energy is managed in-house, the relevant staff will be shielded from the incentive of market competition. This may increase costs in three ways (Globerman and Vining, 1996):

- *X-inefficiency:* The absence of competition may reduce the incentives for energy management staff to minimise production costs. For example, there may be scope for hiring unneeded employees, reducing effort or paying higher prices for inputs. Leibenstein (1966) termed this X-inefficiency.
- *Monopolistic pricing*: An internal energy management cost centre may sell useful energy and related services to other departments within the organisation. Even where the cost centre is relatively efficient, its effective monopoly on supply could lead it to raise prices above the efficient level (Cozier, 1964).
- *Benchmarks*: Senior management may lack adequate benchmarks with which to assess the productivity of energy management staff. This problem may be compounded by inadequate monitoring of energy consumption and costs, coupled with inadequate accounting for those costs in internal company reporting. The combination of inadequate monitoring and benchmarks can reduce the incentive for the relevant staff to minimise costs.

Energy service contracting introduces competitive bidding for the supply of energy management services within the organisation. This is competition *for* the market, rather than competition in it, with the market being defined by the specification in the call for tender. In principle, effective competition should encourage suppliers to price their offers closer to marginal costs, which should reduce the problems of X-inefficiency and monopolistic pricing. The process of competitive tendering should also provide the client with a number of offers, which provide a basis for benchmarking the efficiency of energy management.

Once a contract is awarded, the pressure of competition is removed. But the potential and incentives for X-inefficiency to re-emerge will be constrained by the terms and conditions of the contract, including the use of performance incentives (see below). Additional discipline may be provided by the possibility of the client switching to another provider if the contract terms are breached or if performance is unsatisfactory. Replacing a contractor before the end of a contract term could be costly however, so this incentive may be weak. The contractor may also have an incentive to perform efficiently, in order to maximise the probability of obtaining a follow-up contract. However, the strength of this incentive may be inversely proportional to the contract duration.

4.3.2.3 Performance incentives

Both the advantages of economies of scale and the market incentives of competitive tendering apply equally to conventional turnkey supply and maintenance contracts. But energy service contracting brings three additional benefits:

- Delegating a larger number of activities to an outside supplier, including many that were previously conducted in-house
- Maximising economies of scope and coordination by allocating several responsibilities to a single supplier.
- Ensuring cost savings throughout the duration of the contract by including contractual incentives to maintain and improve equipment performance over time.

The last feature distinguishes energy service contracts from other types of contracts and provides their unique advantage. For example, if the contract includes shared savings provisions, the contractor will have an ongoing incentive to reduce production costs in order to maximise its returns. At the same time, the client will also benefit from any performance improvements. The strength of performance incentives will depend upon how cost savings are measured and how they are shared between the client and the contractor. Incentives will be stronger when the contractor retains a greater proportion of the savings.

In principle, an internal cost centre for energy management could be provided with comparable performance incentives to an outside contractor (‘insourcing’). For example, Irrek *et al* (2005) have used a series of pilot projects to demonstrate the viability of ‘internal performance contracting’ for public sector organisations. They claim that this approach can be effective where the production cost savings are too small to cover the transaction costs of an external contract and where sufficient in-house energy management expertise is available. But the disadvantage is that the benefits of economies of scale and competitive bidding are foregone.

In practice, it is unlikely that the internal incentive structure within an organisation will be as effective as the profit motive within a competitive market. Similarly, the transaction costs associated with monitoring and verify energy savings may be as large for internal performance contracting as for an outsourcing contract. Nevertheless, if it is accepted that performance incentives could in principle be achieved through ‘insourcing’ arrangements, the primary benefit of outsourcing lies in the combination of competitive bidding and the scale advantages of outside providers. The remainder of this section focuses on the determinants of these in more detail.

4.3.3 Determinants of production cost savings

For a particular contract with defined scope and depth, the saving in production costs compared to the in-house provision of the relevant services is given by:

$$P_{CL}^{IN} - (P_{CL}^{OUT} + P_{CON}^{OUT})$$

Savings in production costs are achieved when this expression is positive. The larger the saving in production costs, the greater the viability of contracting.

The saving in production costs that is achieved by a contract will depend upon the technical potential for reducing production costs, compared to the in-house benchmark (*potential savings*). The extent to which this technical potential is achieved (*actual savings*) should depend upon:

- the <u>aggregate</u> production costs for energy services within the client organisation;
- the <u>specificity</u> of the technologies and skills required to provide the energy services included in the contract; and
- the <u>competitiveness</u> of the energy service market.

These are discussed below.

4.3.3.1 Aggregate production costs

The extent to which the contractor has an advantage in terms of economies of scale will depend upon the relative 'size' of the contractor compared to the client. In the case of the contractor, the relevant measure of size is the total production costs for energy services for all the organisations served by the contractor. In the case of the client, the relevant measure is the total production costs for energy services for all the sites owned by the client. 'Production costs' here refers to the total costs for supplying energy services, but a useful proxy is the annual purchase costs for energy commodities since this usually forms the largest component.

Production costs for the client will depend upon the turnover of the organisation and its energy intensity - measured as the percentage of input costs accounted for by energy. Hence, an energy intensive organisation with a small turnover could be the same 'size' in energy terms as a larger organisation that is not energy intensive. There is likely to be a difference, however, in the nature of end-uses - with the former being more process-specific.

Total production costs for the client will also depend upon the number of sites under its control. While individual sites may have relatively small energy bills, an energy service contract may be feasible for a group of sites owned by a single client (e.g. a retail chain).

While smaller clients may lack both staff and technical resource for energy management, larger clients should have a dedicated and competent in-house team. Hence, we would expect the contractor's advantage in terms of economies of scale to be inversely related to the size of the client organisation. It need not follow, however, that there is a threshold size beyond which contracting has no advantages. Instead, the implication is that the potential for contracting to reduce energy costs (in percentage terms) compared to the in-house benchmark may be expected to fall as the size of the client increases.

Note that the relevant variable is the aggregate energy costs for the client organisation, even if only a portion of those costs is to be included within an energy service contract. This is because it is the aggregate energy costs that will determine the resources the client devotes to energy management, and these in turn should be correlated with its competence in energy management. However, both the pattern of energy consumption at the site and the scope of the contract may be complicating factors. For example, if energy costs are dominated by electricity use, the client may lack competence in fuel and heat supply. In this instance, a contractor specialising in heat supply may have a comparative advantage.

4.3.3.2 Specificity of technologies and skills

The extent to which a contractor has an advantage in terms of economies of scale will also depend upon the scope of the contract, since this will determine the technologies and skills required to provide the relevant useful energy stream(s) or final energy service(s). ESCOs primarily have expertise in *generic* energy technologies, such as building management systems, boilers, CHP, chillers, air compressors, lighting systems and air conditioning units. These are proprietary and accessible technologies, which are relatively standardised and utilised by a range of sectors. In contrast, most ESCOs do not have comparable expertise in industrial process technologies such as machining, distillation or fractionation. These tend to be *specific* to an individual sector (or even site), inaccessible to non-experts and highly sensitive to clients, who are concerned about continuity of production, product quality and 'maintaining control'.

It is important to separate two issues here. Sensitivity to production interruptions, combined with a desire to maintain in-house control, may well be an obstacle to contracting. But this is separate from the relative competence of the client or contractor in installing and operating the relevant technology. For example, steam supply may be just as important for continuity of production as the process technology that uses the steam. But while ESCOs may have a relative advantage in the former, they are unlikely to have a comparable advantage in the latter. Similarly, while concern over maintaining control may ultimately be overcome, the relative disadvantage of ESCOs in terms of process technologies is likely to remain and could create an enduring obstacle to extending energy service contracting 'beyond the first process valve'.

4.3.3.3 Competitiveness of the energy service market

While both aggregate production costs and contract scope should influence economies of scale, the competitiveness of the energy service market should influence market incentives. Limited competition provides scope for X-inefficiency and monopolistic pricing by the contractor, which will be reflected in higher bid prices and inefficiencies in contract execution. Limited competition also provides fewer benchmarks in the form of competing bids against which a client can evaluate a particular offer.

In principle, the problems of X-inefficiency and monopolistic pricing may be mitigated if the market is *contestable* - that is, if new suppliers are able to enter at relatively low cost (Baumol, Panzar *et al.*, 1982). In these circumstances, the threat posed by the possibility of new ESCOs entering the market could discipline incumbent firms and encourage them to reduce their bid prices and execute contracts efficiently. As a result, relative efficiency may be achieved, even when the market is highly concentrated.

Markets are contestable when profit levels are high, barriers to entry are low and barriers to exit are low (Baumol, Panzar *et al.*, 1982). In practice, however, the barriers to entry in the energy services market may be relatively high. This is because a successful contractor must be sufficiently large to provide security for loans, and must combine a mix of technical, managerial and marketing skills that will take time to develop. Furthermore, the potential for new contractors to enter the market will not provide clients with adequate benchmarks to evaluate competing bids. This suggests that the most important factor may be actual competition, in terms of the number of firms bidding for a particular contract, rather than more abstract notions of contestability.

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The European energy service market is smaller, more concentrated and less competitive than in the US, and is further split by functional specialisation. In the UK, the companies specialising in supply contracts for industry rarely compete with those specialising in performance contracts for buildings. Similarly, while the largest ESCOs in the EU are multinationals (e.g. Dalkia), a large number of companies remain confined to their national markets. In principle, market growth should encourage competition, which by lowering bid prices should encourage further market growth. But this ‘virtuous circle’ has yet to be established in many Member States.

4.3.4 A theoretical model of production cost savings in energy service contracts

In summary, energy service contracting offers the potential to reduce the production costs of providing energy services, compared to the alternative of in-house provision. This is because: a) energy service contractors can provide economies of scale in the provision of energy services; b) competitive tendering can provide energy service contractors with an incentive to minimise bid costs; and c) performance incentives within the contract can provide energy service contractors with an ongoing incentive to minimise costs. Since performance incentives should, in principle, be achievable through ‘internal performance contracting’, the primary advantage of contracting lies in the market incentives it introduces, combined with the economies of scale of an external provider.

The actual saving in production costs in a particular contract will depend upon:

- the technical potential for production cost savings for the energy services included within the contract (in £k);
- the aggregate production costs for all energy services within the client organisation;
- the specificity of the technologies and skills required to provide the energy services included in the contract; and
- the competitiveness of the energy service market.

These propositions are illustrated in Figure 4.1. The terms in brackets indicate whether the variable depends upon the client organisation (o), the contract scope (s), and/or the market and institutional context (c). The circumstances that are favourable and unfavourable to achieving production cost savings are illustrated in Table 4.3

Figure 4.1 Determinants of achieved saving in production costs

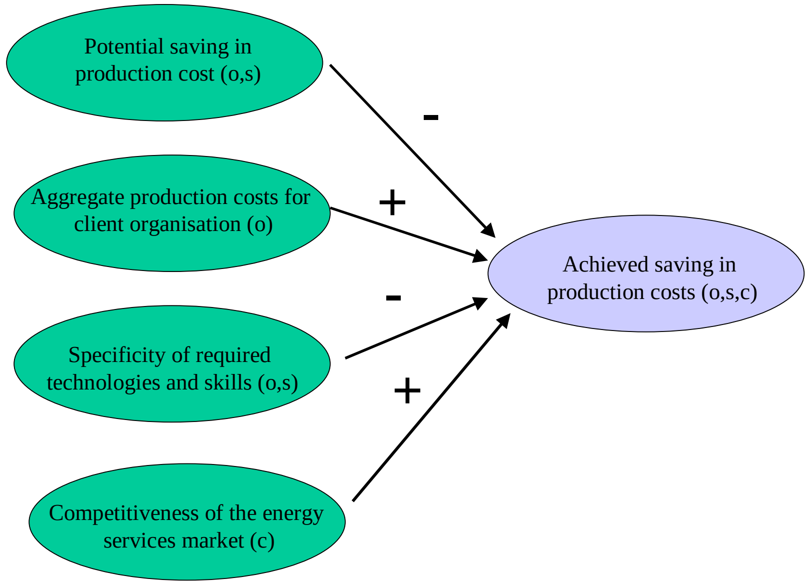


Table 4.3 Circumstances that are favourable to achieving production cost savings through an energy service contract

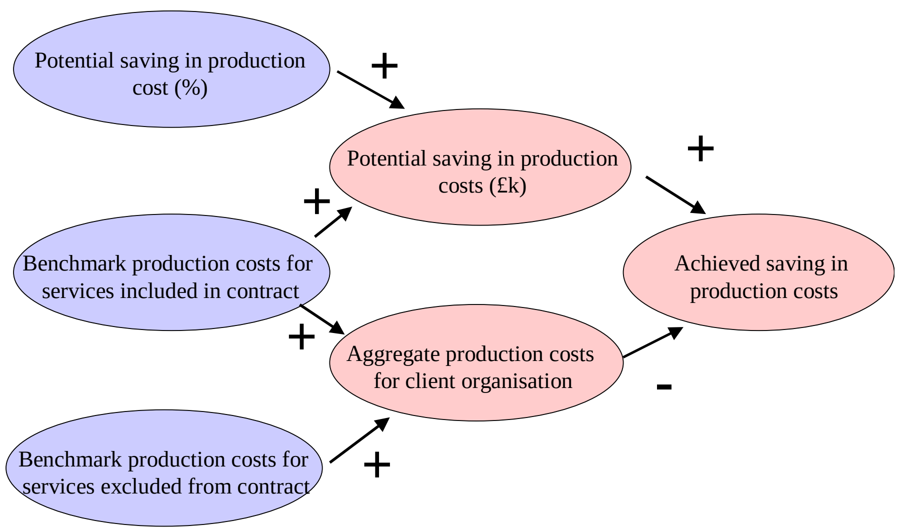
	Favourable for maximising production cost savings	**Unfavourable for maximising production cost savings**
Technical potential for production cost savings for services included in contract	High	Low
Aggregate production cost for client organisation	Low	High
Specificity of required technologies and skills for services included in contract	Low	High
Competitiveness of the energy service market	High	Low

The technical potential for production cost saving should be proportional to the in-house benchmark production costs for the energy services covered by the contract. At the same time, the potential for realising those savings should be inversely proportional to the aggregate production costs for the client organisation. The net result is a slightly complex relationship between cost savings and different measures of client 'size' that is illustrated in Figure 4.2.

In principle, the same absolute saving in production costs could be achieved by a large percentage saving at a client site where benchmark production costs are small, or a smaller percentage saving at a client site where benchmark production costs are large. The above framework suggests that the percentage savings should decrease as the aggregate 'size' of the client organisation increases, as measured by the aggregate production costs for supplying energy services in the organisation. At the same time, the benchmark production costs for the services included in the contract should increase as the aggregate size of the client increases. Hence, these two variables are partially offsetting one another.

In all cases the relationship between benchmark production cost for the services included in the contract (B) and the aggregate production cost for the client organisation (A) will depend upon the scope of the contract. Widening contract scope should increase the ratio of B to A, as well as the potential cost savings. Narrowing contract scope should do the opposite.

Figure 4.2 Relationship between measures of client 'size' and achieved saving in production costs



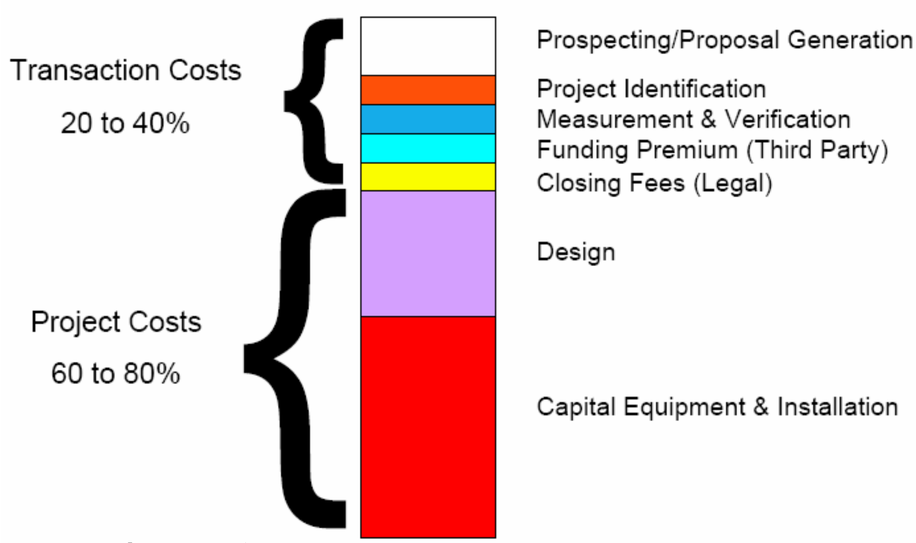
The saving in production costs is only half the story, however, since we must also consider the transaction costs involved in establishing and monitoring the contract. The next section examines the determinants of transaction costs in more detail.

4.4 Transaction costs and energy service contracts

4.4.1 Transaction costs from a practitioners' perspective

The importance of transaction costs for energy service contracts is widely acknowledged, although most practitioners are unaware of the formal theory with which transaction costs are associated. From a practitioners' perspective, the term refers to the organisational costs associated with identifying prospective clients, conducting energy audits, identifying potential cost savings, negotiating and writing contracts, organising financing, monitoring and verifying energy cost savings and so on. These costs are separate from the production costs described above and are commonly regarded as substantial. For example, Figure 4. compares the transaction costs for a US performance contract with the capital costs of investment.

Figure 4.3 Transaction costs incurred by a contractor in establishing a performance contract



Source: (Easton Consultants, 1999)

Easton Consultants (1999) have suggested that transaction costs routinely form up to 40% of the total costs of a US performance contract, and sometimes as much as 66%. This is approximately double that for a more conventional turnkey or maintenance contract, with M&V accounting for a large part of the difference. Hence, the 'added value' of a performance contract must be sufficient to offset these additional costs. Moreover, a large proportion of these transaction costs (e.g. legal fees) are either fixed, or only weakly related to the volume of energy under contract.

4.4.2 Transaction costs from an economists' perspective

The importance of transaction costs was first recognised by Coase in 1937, and subsequently developed into a comprehensive theoretical framework by Williamson (1985). In TCE, the term transaction refers to the transfer of goods, services or property rights, whether externally within markets or internally within organisations (Furubotn and Richter, 1997). Transaction costs are the legal, administrative, information gathering and other costs associated with organising these transfers. Table 4.4 summarises the different components of these costs for market and organisational transfers respectively. The key argument of TCE is that the relative magnitude of these costs provides a primary explanation for the choice of organisational arrangements in general and the choice between markets and hierarchies in particular (Williamson, 1985).

Table 4.4 Transaction costs in markets and organisations

Type		**Examples**
Market (external)	Search and information costs	Searching for parties with whom to contract; communicating; gathering information about price and quality.
	Bargaining and decision costs	Bargaining and negotiating costs; time and legal advice; costs of making any information gathered usable; compensation paid to advisers; cost of reaching decisions.
	Supervision and enforcement costs	Monitoring contract terms; measuring product/service quality; measuring the valuable attributes of what is being exchanged; protecting rights; enforcing contractual provisions.
Organisational (internal)	Establishing organisations	Costs of setting up, maintaining or changing and organisational design, including incentive design, information technology, public relations, lobbying, etc.
	Running organisations	Costs of decision-making, monitoring the execution of orders, measuring the performance of workers, agency costs, costs of information management etc.

Source: Based on Furubotn and Richter (1997, p. 43-47)

TCE claims that transaction costs result from two unavoidable features of human behaviour: bounded rationality and opportunism.

- *Bounded rationality* provides a more realistic account of human decision-making than is traditionally assumed within orthodox economic theory. It suggests (quite reasonably) that people make decisions subject to constraints on their time, attention, resources and ability to process information. As a result, they utilise routines and rules of thumb and tend to make satisfactory rather than 'optimal' decisions. Since individuals do not have the capacity to foresee every contingency that might arise, any contracts they engage in will be 'incomplete' in that they will not specify the actions to be taken in all circumstances.
- *Opportunism* provides a more jaundiced account of human nature than is traditionally assumed within orthodox economic theory. Williamson defines opportunism as: '… self interest seeking with guile. This includes but is scarcely limited to more blatant forms, such as lying, stealing and cheating..…more generally, opportunism refers to the incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse.' (Williamson, 1985, p. 47). Note that it is not necessary to assume that all individuals are given to opportunism to recognise the value of this assumption in explaining a number of observed economic arrangements and outcomes. For example, it is not necessary to assume that all people are potential thieves in order to explain the commonly observed practice of locking a house

Since bounded rationality and incomplete information prevent fully effective monitoring of contractual behaviour, there is always the risk that the other party will act opportunistically - for example, by claiming that cost reductions result from performance improvements when their real origin lies elsewhere.

TCE claims that market, organisational and contractual arrangements are chosen to minimise transaction costs, or more specifically '…to economise on bounded rationality while at the same time safeguarding against the hazards of opportunism' (Williamson, 1985, p. 32). TCE locates these so-called *governance structures* on a spectrum, with spot markets at one end and hierarchical organisations at the other. Market structures provide powerful incentives for exploiting profit opportunities and allow quick adaptation to changing circumstances, but expose parties to the risk of opportunistic behaviour when investment in 'specific assets' is required (see below). In contrast, hierarchies reduce the scope for opportunistic behaviour but provide weaker incentives to maximise profits. In between these two idealised forms are contractual relationships of increasing duration and complexity, together with hybrid forms such as joint ventures and 'partnering'. Energy service contracting represents a shift from a hierarchical form of organisation (in-house energy management) to a more market-based form.

Transaction costs may be incurred both during contract negotiation (ex-ante) and subsequently during contract execution (ex post). The latter may usually be anticipated and allowed for during the negotiating stage - for example the costs involved in monitoring contract compliance. Hence, the proposition that transaction costs explain the choice of governance structure implies that the relevant transaction costs are subjective and uncertain - they include costs that are estimated at the time of making a decision (Masten, 1993). If the actual transaction costs turn out to be different from those anticipated, the chosen governance structure may be sub-optimal. Market forces may eliminate sub-optimal governance structures over time, but these processes may be slow.

Transaction costs also represent both real and opportunity costs (Masten, Meehan *et al.*, 1989, ; Reindfleisch and Heide, 1997). For example, negotiating changes to a contract in response to external changes represents a real cost, while failure to adapt effectively to those changes represents an opportunity cost. The expectation of both may influence the choice of governance structure, while the actual occurrence of both may influence the subsequent performance of that structure (e.g. the success of the contract).

TCE focuses on the role of transaction costs in explaining the choice of governance structures. But as argued in the previous section, the choice of governance structure may influence production costs as well. Hence, *a comprehensive theory of organisational choice must examine the combined effect of the two*.

4.4.3 Determinants of transaction costs

Both the client and contractor will incur transaction costs in preparing, negotiating, establishing, executing, monitoring and enforcing an energy service contract. The size of these costs can be expected to vary with the nature of the outsourced services, the scope, depth and method of finance of the contract and various features of the external environment. TCE reduces this complexity to a small number of relevant variables, which are claimed to explain the choice of governance structure in a wide variety of situations. Hence, if the relative magnitude of these variables for different contracts can be identified, the viability of those contracts may be assessed.

Generally speaking, we would expect an energy service contract to lead to an increase in transaction costs compared to the alternative of in-house provision. The smaller the increase in transaction costs, the greater the viability of contracting.

TCE suggests that the transaction cost of contracting should depend upon:

- the specificity of the assets required to provide the energy services included within the contract;
- the complexity of the energy services included within the contract and the associated difficulty in specifying and monitoring contractual terms and conditions
- the competitiveness of the energy service market; and
- the institutional context in which contracting takes place.

These are discussed in turn below.

4.4.3.1 Asset specificity

Assets are required to provide any energy service. In TCE terminology, the relevant assets include both physical systems, such as lighting, and the knowledge and expertise required to install, operate and maintain those systems, such as skilled engineers ('human assets'). While some assets are common, others are dedicated to a particular use and are said to be *specific*. An asset is specific if it makes a necessary contribution to the production of a good or service and has much lower value in alternative uses (Klein, Crawford *et al.*, 1978). For example, money may be considered a non-specific asset, since it can be transferred from one transaction to another without any loss in value (Aubert, Rivard *et al.*, 1996, p. 2). In contrast, a lighting system may be considered a specific asset, since there will be relatively limited scope for transferring it to another location, if it is no longer needed within an existing contract.

Investment in specific assets makes the investor vulnerable to opportunism by the other party. For example, an ESCO that invests in a CHP scheme that is located within a separately owned chemical plant has limited bargaining power should the plant owners demand a lower price for the heat. This is because there is probably no other customer to whom the heat could be sold (the 'hold-up' problem). As a result, the ESCO would probably have to accept a lower price for the heat, since (provided variable costs are covered) this is better than losing the investment altogether. Similarly, the investment by a contractor in understanding a particular client's organisational procedures represents a sunk cost that cannot be recovered if the contract is terminated.

Transactions that require one party to invest in specific assets will increase the potential for opportunism by the other party. To protect such assets, the investing party will seek to obtain some form of promise from the other party before making the investment. In the case of supply contracting, for example, this could take the form of a long-term contract that includes take or pay provisions. As the specificity of the required assets increases, these protection causes are likely to become more numerous, complex and costly, both to establish and to enforce. As a result, the increase in transaction costs could undermine the savings in production costs that the governance structure achieves. When these costs become too high, it may be more appropriate to conduct the transaction in-house.

Three types of asset specificity are relevant to energy service contracts:

- *Site specificity*: Energy service contracts require a contractor to locate physical equipment on the client site. In some cases (e.g. package boilers), this equipment will be relatively easy to relocate and hence will retain value outside of a particular contract, but in many other cases the equipment will be difficult to relocate because it is designed and engineered for a particular site (e.g. a heat distribution network). This equipment may be considered site specific because it has only limited resale or scrap value. While some supply contracts may export electricity or heat or both, most contracts will rely on continuing energy service demand from within the client site and hence on both the economic viability of the client and the stability of end-use demand. Uncertainty over either will undermine the potential for contracting. If the site has a rental value (e.g. commercial buildings) it is possible that energy service demand may continue following a change in ownership, but this is likely to require contract renegotiation.

- *Physical asset specificity:* All energy service contracts will require investment in data gathering and auditing, some will require specialised equipment, and many will require design and engineering to meet specific physical constraints and technical requirements. This investment represents a sunk cost that will be lost if the contract is either not signed or is terminated early. Performance contracts in particular require a detailed and costly 'investment greater audit' (IGA), which generates information that the client could opportunistically use to implement the energy saving projects itself. To mitigate this risk, US performance contractors first conduct a feasibility study and then make a proposal that is subject to the outcome of an IGA. The proposal usually stipulates that client must pay the full costs of the IGA if it chooses not to take up the contract (Singer, 2002). If the client is not prepared to do this, asset specificity may prevent a contracting solution.
- *Human asset specificity:* The extent to which energy service contracts involve specialised knowledge and expertise will depend on the nature of the required technology. As argued earlier, ESCOs tend to specialise in *generic* energy technologies that are suitable for use in a wide variety of applications. Technologies that are specific to an individual industrial process will require investment by the ESCO in hiring additional staff, training existing staff, learning by doing and so on. If relatively few potential clients have comparable technologies, this investment may not be readily transferable elsewhere. Hence, not only will an ESCO have fewer advantages with such technologies in terms of economies of scale, it will also be exposed to greater risk if it makes the required investment. As a result, involvement in process-specific technologies is likely to be avoided.

Contractors will seek to safeguard their investment in site, physical and human specific assets through a variety of means, including increasing contract duration and requiring compensation for contract termination. But longer contracts may limit the client's ability to replace the contractor, to negotiate better terms, or to adapt to changing conditions. Formulaic adjustment mechanisms may help adaptation but are more costly to negotiate, while more flexible adjustment mechanisms may increase the scope for opportunism during the negotiation process. Contract duration will also depend on the size, rate of return and depreciable lifetime of the relevant investments - for example, lighting projects may pay back within three years while insulation projects take longer. But the contract duration suggested by these variables need not necessarily be correlated with the contract duration suggested by the associated level of asset specificity. Contracting will be most problematic for energy services that involve high levels of site, physical and/or human asset specificity and which also require technologies with a low rate of return. Conversely, technologies with a high rate of return can mitigate the risk of asset specificity.

In sum, as asset specificity increases transaction costs may also be expected to increase, making energy service contracts less viable.

4.4.3.2 Task complexity

Task complexity is defined here as the degree of difficulty in specifying and monitoring the terms and conditions of a contract (Globerman and Vining, 1996). The degree of complexity will depend upon the nature of the service being provided. For example, a contract to purchase energy commodities on behalf of a client would be relatively straightforward, since the price and quality of these commodities can be very easily defined and verified. In contrast, a contract to supply comprehensive energy services to a commercial building would be relatively complex, since a variety of environmental conditions (e.g. illumination levels, air flow) would need to be agreed and monitored.

Greater complexity may make it more costly to specify and negotiate contract terms. Clients, for example, may lack information on the current (reference) cost of providing energy services and may need to hire consultants to help them define appropriate service standards and comfort conditions. Greater complexity may also make it more costly to establish and operate monitoring systems, to determine whether the terms of the contract have been met. Sub-metering of hot water flow from a boiler, for example may be cheaper and easier than monitoring temperature, humidity and airflow within a large building. Greater expenditure on monitoring and verification will reduce the costs savings from improved efficiency, while inadequate monitoring may leave the client vulnerable to opportunistic behaviour by the contractor. Since service quality can be difficult to specify and monitor, the contractor's incentive to reduce costs may override the incentive to maintain or improve quality (Domberger and Jensen, 1996).

Greater complexity may also make one or both parties vulnerable to two types of uncertainty (Globerman and Vining, 1996):

- *Environmental uncertainty*: Greater complexity may make the cost and quality of a service more vulnerable to changes in various internal and external factors, such as weather conditions, occupancy patterns and occupant/user behaviour. Such changes may have their origin either within the client organisation or externally, and need to be anticipated and allowed for during contract negotiation if subsequent disputes are to be avoided. But the greater the degree of environmental uncertainty, the more complex and costly the negotiation process is likely to become. If such changes are unanticipated, they may reduce cost savings, undermine service quality or necessitate additional modifications during contract execution. Hence, environmental uncertainty leads to additional bargaining and negotiating costs for the transacting parties, both before and after contract completion.
- *Behavioural uncertainty:* Greater complexity may also increase the information asymmetry between the client and the contractor, which should increase the scope for opportunism. For example, a contractor may blame cost increases on unavoidable external influences, but greater complexity makes it harder for the client to verify this claim. If the energy services market is competitive, opportunism during contract negotiation may be attenuated by the risk of competitors offering more attractive bids. But once the contract is signed, the client is more vulnerable to opportunistic behaviour since there may be significant costs associated with terminating the contract and either replacing the contractor or taking the service back in-house.

Interviews with potential UK clients suggest that concern about contractor opportunism can be an important obstacle to the acceptance of energy service contracts:

> “It is extremely difficult to prove that a CEM company isn’t doing what they could be doing. If your building goes down, they could blame you.…Unless the university is extremely careful in the way that the contracts are written, they could lose a lot of money. Most CEM contracts look good on the surface until you see the hidden extras. Legally the ESCO will comply, but will try their darndest to get the most money out of it they can.”

In general, the complexity associated with supplying a useful energy stream should be less than that associated with supplying a final energy service. Transaction costs will be less when equipment performance is defined by technical and easily quantifiable factors, but the move from supply to performance contracting should increase both the number of factors influencing equipment performance and the proportion that are under user/occupant control (Helle, 1997). Complexity may also vary significantly from one energy service to another.

In sum, as task complexity increases transaction costs may be expected to increase, making energy service contracts less viable.

4.4.3.3 Competitiveness of the energy service market

As argued in Section 4.3.3, limited competition in the market for energy services could encourage contractors to behave opportunistically by pricing bids above marginal costs (Globerman and Vining, 1996, p. 580). However, if the market is competitive, contract prices should be bid down to an efficient level.

In a similar manner, limited competition may create a greater incentive for contractors to behave opportunistically during contract execution, since it is more difficult to find an acceptable replacement. But if the market is competitive, the incentive to ‘cheat’ will be offset by the risk of losing the contract, either prematurely or at the point of renewal. Hence, by reducing the risk of contractor opportunism, greater competition in the energy services market should reduce the transaction costs for the client.

As described earlier, limited competition may be less important if the energy services market is contestable, with low-cost entry and exit. But once a contract is signed, the relevant variable is the contestability of the individual contract. This is a composite of the contestability of the energy service market and the specificity of the assets associated with the individual contract. If the individual contract involves highly specific assets and substantial sunk costs, the contestability of the contract may be low even when the market itself is relatively contestable. In this case, the contract is likely to be of long duration and to include compensation clauses, which could make contract renewal infrequent and premature termination costly. The incumbent contractor is also likely to have client-specific knowledge of technologies and operating procedures, together with better knowledge of the real costs of supply, which could provide it with an advantage over competing bidders at the point of contract renewal.

Competitive markets may not be the only inhibitor of opportunism by the bidding or incumbent contractor. Contractors will be concerned about their reputation, since ‘bad experience’ stories can haunt companies for many years. As a result, contractors that act opportunistically run the risk of losing future business, either from either existing clients or from potential clients. Contractor reputation can be considered as a form of irreversible investment that is built up over time at great cost, so contractors may be reluctant to jeopardise it for short-term gain (Wang, 2002, p. 157).

Clients may also mitigate the risk of opportunistic behaviour by retaining the capability of bringing the relevant energy services back in-house (‘back sourcing’). However, since such capability may be expensive to maintain, this option could undermine many of the benefits of choosing outsourcing. Another alternative would be for the client to retain ownership of specialised and specific assets and to lease these to the contractor, thereby making it easier to change contractors if necessary (Globerman and Vining, 1996). But this approach may be less effective when specific knowledge is required to operate the equipment.

In sum, as competition in the market the energy services increases, transaction costs may be expected to reduce making energy service contracts more viable.

4.4.3.4 Institutional context

Transaction costs will also depend upon various features of the legal, financial and regulatory context, such as public procurement legislation, the availability of project finance and the existence or otherwise of specific policy initiatives to encourage contracting. For example, the effectiveness with which the legal system establishes, maintains, protects and enforces contractual obligations will affect the viability of the contracting approach (North, 1990). The institutional context may be expected to vary between different countries and to a lesser extent between different sectors.

Some features of the institutional context may actively inhibit contracting. For example, the risk and cost of bidding procedures under the UK government's Private Finance Initiative appears to have discouraged ESCOs from establishing contracts with otherwise attractive public sector organisations (Section 3.3.7). In contrast, the institutional factors that may actively encourage contracting include:

- *Information schemes*: Clients will incur transaction costs in understanding and identifying the opportunities available, while ESCOs will incur marketing costs that need to be recovered from successful contracts. These may potentially be reduced through publicly funded information programmes and demonstration schemes that raise awareness and demonstrate the viability of energy service contracting in different sectors.
- *Public sector procurement*: Transaction costs may be lowered by standardised tendering and procurement procedures and measures to reduce the cost and risk of bidding. The success of performance contracting in the US public sector owes much to such initiatives at the federal and state level.
- *Accreditation*: Accreditation and certification of ESCOs may reduce the risk of opportunism, enhance ESCOs reputation and give assurance to clients that standards will be maintained. Accreditation effectively acts as a form of ‘signalling’, to communicate private information in a credible way (Spence, 1973). The best example is the US trade association (NAESCO), who sponsor an accreditation programme to demonstrate technical and managerial competence and commitment to ethical business practices. This is sufficiently rigorous that only half of the eligible members have qualified.
- *Monitoring and verification protocols*: Standardised and widely recognised protocols for monitoring and verification (notably the IPMVP) may reduce costs for both client and contractor in establishing an M&V system, increase confidence in the energy and cost savings achieved, reduce the risk of opportunistic behaviour by the contractor, decrease the likelihood of subsequent disputes and facilitate access to lower cost financing

- *Model contracts:* Standardised contracts may reduce the cost to both client and contractor in preparing and negotiating an individual contract, as well as making it easier to compare and evaluate competing bids. Many ESCOs appear reluctant to use model contracts since they consider that contracts need to be tailored to individual client circumstances. But the approach may be feasible for smaller clients with relatively standardised requirements, for whom the transaction costs of contracting are a particular obstacle.
- *Consultancy*: Clients may benefit from expert and independent assistance in establishing baseline data, defining contract scope, assessing bids and negotiating with contractors. Public funding for this would reduce transaction costs for the client, reduce the information asymmetry between the client and contractor and reduce the client's vulnerability to opportunism. However, this support would be at the taxpayers expense.

Measures such as these have been widely advocated (Vine, 2005), and may partly explain the differing success of energy service contracting for otherwise comparable markets in different countries (Bertoldi, Rezessy *et al.*, 2005). However, several of these initiatives require public funding and evidence on their aggregate costs and benefits appears to be limited.

4.4.4 A theoretical model of transaction costs in energy service contracts

In summary, energy service contracting will involve transaction costs for both the client and contractor and the sum of these is likely to exceed the transaction costs associated with the in-house provision of energy services. The magnitude of these costs in a particular instance should depend upon:

- the specificity of the assets required to provide the energy services included within the contract;
- the difficulty in specifying and monitoring contractual terms and conditions (task complexity);
- the competitiveness of the energy service market; and
- the institutional context in which contracting takes place.

These propositions are illustrated in Figure 4.nn. As before, the terms in brackets in Figure 4.6 indicate whether the variable depends upon the client organisation (o), the contract scope (s), and/or the market and institutional context (c). The circumstances that are favourable and unfavourable to minimising transaction costs are illustrated in Table 4.5

Figure 4.4 Determinants of transaction cost of contracting

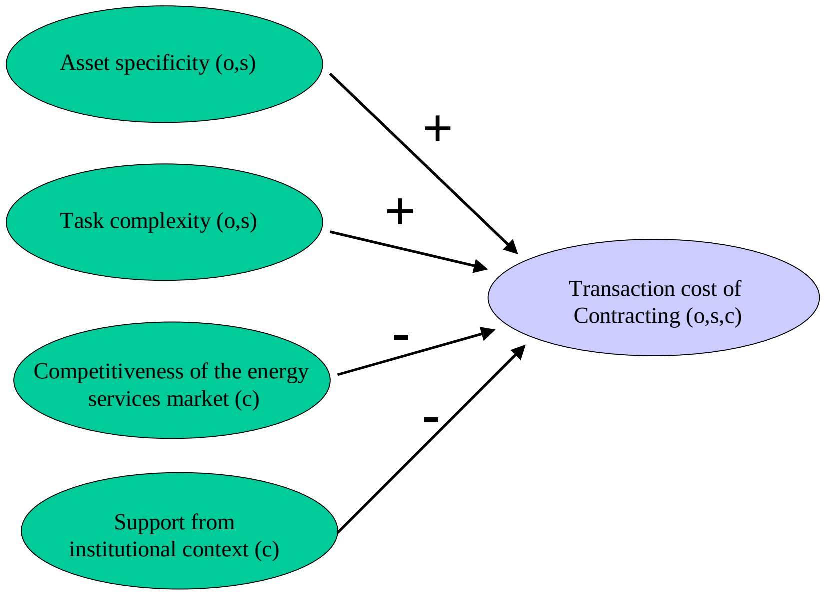


Table 4.5 Circumstances that are favourable to minimising transaction costs in energy service contracts

	Favourable for minimising transaction costs	**Unfavourable for minimising transaction costs**
Asset specificity	Low	High
Task complexity	Low	High
Competitiveness of the energy service market	High	Low
Support from institutional context	High	Low

It is important to note that there need not be a correlation between asset specificity and complexity. For example, a contract to maintain building environmental conditions is likely to be complex, but need not involve investment in 'human specific' assets since the relevant technologies (e.g. building energy management systems) are generic. In contrast, many process technologies are specific to an individual sector, but are not necessarily complex. However, energy service contracting can be expected to be most problematic for those organisations and energy services where asset specificity and complexity are combined.

Table 4.5 summarises the contribution of asset specificity and task complexity to transaction costs, and shows the relative contribution of behavioural uncertainty and environmental uncertainty. In brief, asset specificity creates a *safeguarding* problem, environmental uncertainty creates an *adaptation* problem and behavioural uncertainty creates a *measurement* problem. Each leads to direct and opportunity costs, both prior to contract signature (ex ante) and during contract execution (ex post). As these costs increase, the viability of contracting is reduced.

Table 4.5 How asset specificity and task complexity influence transaction costs

	Asset specificity	**4.4.4.1.1 Task complexity** **Environmental uncertainty**	**Behavioural uncertainty**
Nature of governance problem	Safeguarding investments	Adapting to changed circumstances	Evaluating performance
Origin	Vulnerability to exploitation of specific assets due to opportunistic behaviour of other party.	Difficulty in specifying and modifying contract terms to accommodate changed circumstances	Difficulty in assessing the performance and contractual compliance of exchange partners.
Behavioural antecedents	Opportunism	Bounded rationality	Bounded rationality and opportunism
Energy service example	Contractor may need to spend time learning the operating procedures of the client - this knowledge is not transferable.	Contractor may find that the demand for energy services has dropped, owing to changes in product demand.	Client may find it difficult to determine actual energy savings, and to assess whether these are due to the contractor or other factors.
Direct transaction costs	Costs of crafting safeguards within contracts (ex ante) Threat of hold-ups (ex-post)	Communication, negotiation and coordination costs (both ex ante and ex post)	Screening and selection costs (ex ante) Measurement costs (ex post)
Opportunity costs	Failure to invest in productive assets	Failure to adapt, or maladaptation	Failure to identify appropriate partners (ex-ante) Productivity losses through effort adjustments (ex post)

Source: Adapted from Reindfleisch and Heide (1997).

4.4.5 Limitations of the transaction cost approach

The preceding discussion places much emphasis on the risk of self-interested, opportunistic behaviour by economic agents. This is a characteristic feature of TCE, which assumes that safeguards against such opportunistic behaviour will either be achieved through legal provisions within contracts, or through a move towards more hierarchical forms of organisation, such as vertical integration. This emphasis on opportunism has attracted criticism from sociologists and others who argue that transactions are embedded within a social context and frequently involve personal relationships infused with *trust* (Chiles and McMackin, 1996, ; Lazaric and Lorenz, 1998, ; Lorenz, 1999). The existence of such trust may potentially reduce the risk of opportunistic behaviour, reduce the need for costly contractual safeguards, allow contracting to take place in conditions of relatively high asset specificity and task complexity, and improve the overall performance of such contracts. Consideration of the role of trust has stimulated a diverse academic literature, while the increasing use of 'partnering' relationships within business is cited as evidence of its practical importance (Meer-Kooistra and Vosselman, 2000).[19]

[19] This follows the trend seen in other sectors, such as construction (Barlow, Cohen *et al.*, 1997) and defence (Parker and Hartley, 2003).

Trust may arise from three sources (Chiles and McMackin, 1996). First, individual and inter-organisational relationship will be influenced by general norms of behaviour established both in society at large and within particular professional and occupational sectors. This creates expectations that obligations will be honoured and promises kept. Second, trust may arise from personal relationships that arise in the course of repeated exchanges during the negotiation and execution of contracts (Granovetter, 1985). These may reinforce social norms by establishing friendships, while detailed contractual provisions may actually damage such friendships by signalling a lack of trust (Macaulay, 1963). Third, 'trust like behaviour' may arise from rational economic calculation, as exemplified by the predictions of game theory (Husted, 1989). In some cases, the long-term benefits to be gained from maintaining a contractual relationship with another party could outweigh the short-term benefits of behaving opportunistically. Recognition of this may reduce the incentive for such behaviour.

Whatever its origin, trust may potentially economise on transaction costs by reducing the risk of opportunistic behaviour (Meer-Kooistra and Vosselman, 2000). If there is trust between contracting parties, there may be less need for elaborate and costly legal safeguards. Contracts may be specified more loosely, with the expectation that any difficulties or unexpected events will be dealt with fairly. Trust may decrease the cost of monitoring performance, since there is less concern that the other party will exploit any information asymmetries. And trust may allow transactions to be governed through contracts that, in the absence of trust, would need to be governed internally.

Consideration of the role of trust may therefore modify the basic TCE framework and provide an alternative route to mitigating opportunism. However, the empirical evidence for the role of trust is mixed and there is a lack of consensus over whether trust is a substitute for a complement for detailed contractual provisions (Poppo and Zenger, 2002). This suggests a need for empirical work to explore the role of trust in different contractual relationships and its influence upon contractual performance.

4.5 A theoretical model of energy service contracts

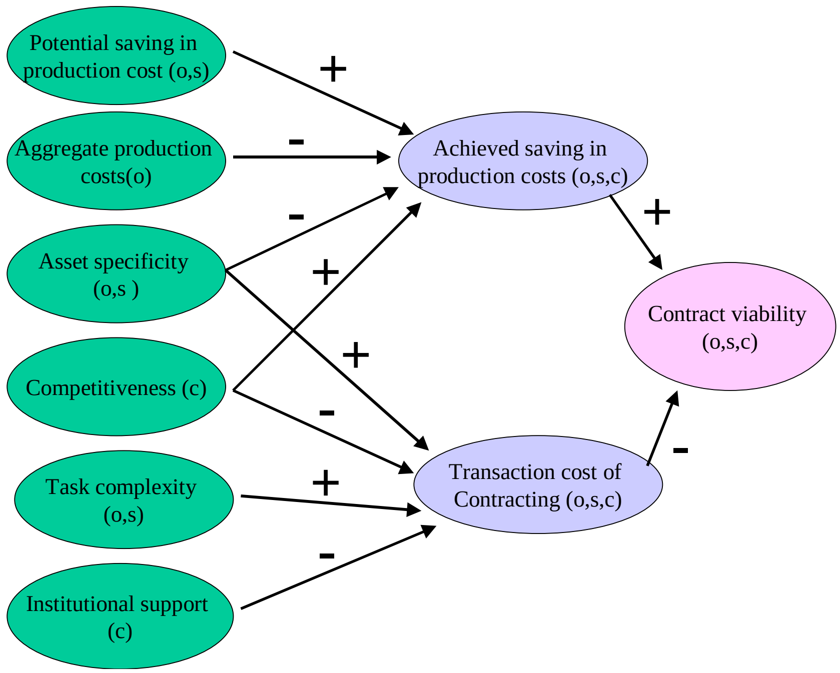
4.5.1 Theoretical model

The previous sections have examined the determinants of production cost savings and transaction costs in detail. The results of this analysis are summarised in Figure 4.6. The dependent variable, contract viability, is positive (viable) if production cost savings exceeds transaction costs and negative (not viable) if they do not.

In this model, the saving in production cost and the transaction cost of contracting are each determined by four variables, with the variables asset specificity and competitiveness being common to both. In practice, not all elements of asset specificity will be relevant to production cost savings: for example, physical specificity will be relevant but site specificity will not. However, combining the variables in this way provides a useful simplification.

As before, the terms in brackets in Figure 4.6 indicate whether the variable depends upon the client organisation (o), the contract scope (s), and/or the market and institutional context (c).

Figure 4.5 Summary of the theoretical model



4.5.2 Hypotheses

This model may provide some insight into the key outsourcing question:

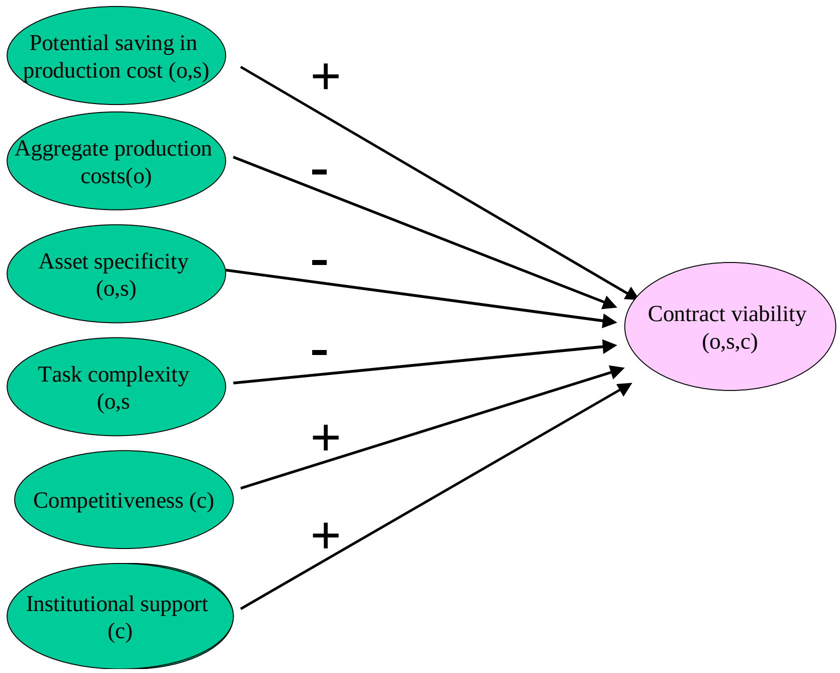
What explains an organisation's decision to outsource (or not to outsource) a particular energy service?

As argued in section 4.2, a client will only establish enter into an energy service contract if it expects the contract payments to be less than the savings achieved. Similarly, a contractor will only provide an energy service contract if it expects the contract revenues to be greater than the costs incurred. Both conditions will only hold if the total savings in production costs achieved through the contract are greater than or equal to the total increase in transaction costs for the client and contractor combined.

The same logic applies to the decision to include a particular energy service within the scope of a contract. For the client, the additional contract payments must be less than the additional savings achieved; while for the contractor, the additional contract revenues must exceed the additional costs incurred.

The theoretical model establishes links between these costs and a number of independent variables that may be either assessed by the client or contractor, or measured by a researcher. Assessing the relative magnitude of these variables may prove easier than attempting to quantify the various costs directly. These variables will take different values according to the choice of client organisation (o) and contract scope (s), as well as the market and institutional context (c). Figure 4.7 links the independent variables directly to the viability of an energy service contract.

Figure 4.6 Determinants of contract viability



This framework suggests six hypotheses, which are summarised in Box 4.1.

Box 4.1 Hypotheses regarding the viability of energy service contracts

Energy service contracting is more (less) likely to be used in situations where:

- *H1:* the technical potential for production cost savings for the energy services included within the contract are large (small);
- *H2:* the aggregate production costs for all energy services within the client organisation are small (large);
- *H3:* the specificity of the assets required to provide the energy services included within the contract are low (high);
- *H4:* the task complexity, as measured by the difficulty in specifying and monitoring contractual terms and conditions is low (high);
- *H5:* the market for energy service contracts is more (less) competitive;
- *H6:* the relevant institutional framework is more (less) conducive to contracting.

Table 4.nn relates these hypotheses to the choice of client organisation and contract scope and to the relevant market and institutional context.

Table 4.6 Mapping independent variables onto choice of organisation, choice of contract scope and market/institutional context

	Independent variable	**4.5.2.1.1 Influenced by**		
		Client organisation	**Contract scope**	**Context**
H1	Technical potential	✓	✓	
H2	Aggregate production costs	✓		
H4	Asset specificity	✓	✓	
H5	Task complexity	✓	✓	
H6	Competitiveness			✓
H7	Institutional support			✓

These hypotheses provide some insight into the appropriateness and likely success of an energy service contract in different circumstances. Four of the independent variables are relevant to explaining why particular organisations choose energy service contracting, three are relevant to explaining why particular energy services are included in or excluded from the contract, and two are relevant to explaining why the take-up of energy service contracts varies between comparable organisations in different contexts (e.g. the US and the UK).

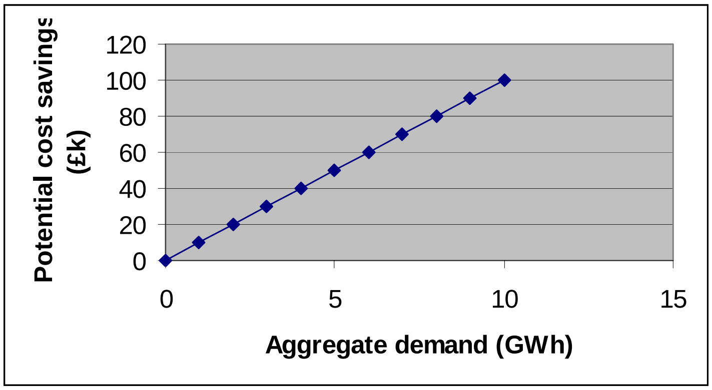
Within a single country, the 'context' variables may be largely fixed. The possible exceptions include different levels of competitiveness for different types of energy service contract (e.g. supply contracts versus performance contracts), and institutional obstacles or supports that apply in one sector but not in others (e.g. public versus private sector). If these differences can be ignored, the explanatory model for the take-up of energy service contracts within a single country reduces to only four independent variables.

4.5.3 Contracting and client size

As they stand, the hypotheses do not provide clear guidance regarding the minimum 'size' of client for which an energy service contract may be viable. To assess this important question, it is necessary to consider four variables in turn.

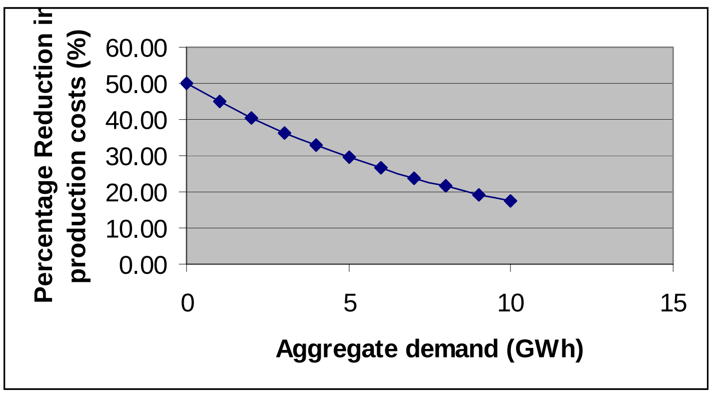
The first variable is the technical potential for production cost saving. Since this is proportional to the in-house benchmark production costs for the energy services covered by the contract (Figure 4.2), it should also be proportional to the aggregate production costs for the client organisation and hence to the aggregate energy demand. Figure 4.7 provides a stylised illustration of the potential for cost savings versus energy demand.

Figure 4.7 Potential saving in production cost versus aggregate energy demand



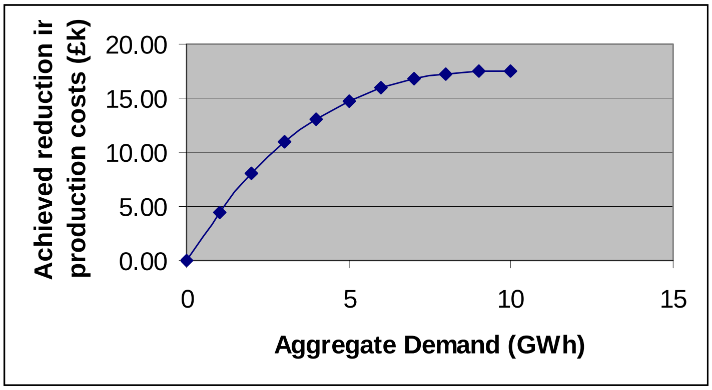
The second variable is the percentage reduction in production costs achieved through the energy service contract. Since this depends on the relative advantage of the contractor in terms of economies of scale, it should be inversely proportional to the aggregate production costs for the client organisation and hence to the aggregate energy demand. Figure 4.8 graphs the percentage saving in production costs against energy demand.

Figure 4.8 Percentage reduction in production costs versus aggregate energy demand



The third variable is the absolute reduction in production costs achieved by the contract. This is given by the product of the above two variables, and is illustrated in Figure 4.9. In this example, there is a levelling off in achieved savings. Whether this happens in practice will depend upon the shape of the above two curves.

Figure 4.9 Achieved saving in production costs versus aggregate energy demand



The final variable is the transaction cost of contracting. Client 'size' was not included in the model as one of the determinants of transaction costs, since it was anticipated that transaction costs will be only weakly related to client size. It is true that larger contacts may be associated with higher transaction costs if they involve large-scale projects or the use of project financing. On the other hand, a large proportion of transaction cost (e.g. legal fees) are likely to be fixed, to depend upon the scope and depth of the contract rather than client size, or to be only weakly related to client size. For example, some large projects (e.g. heat supply) may be relatively simple, while some small projects (e.g. building services) may be relatively complex. This makes the relationship between transaction costs and measures of client 'size' both complex and specific to individual contracts. The best that can be said is that transaction costs are likely to include a large fixed component and to increase more slowly with client 'size' than the associated technical potential for production cost saving. This is illustrated in Figure 4.10, which assumes a linear relationship between transaction costs and aggregate energy demand.

Figure 4.10 Transaction costs versus aggregate energy demand

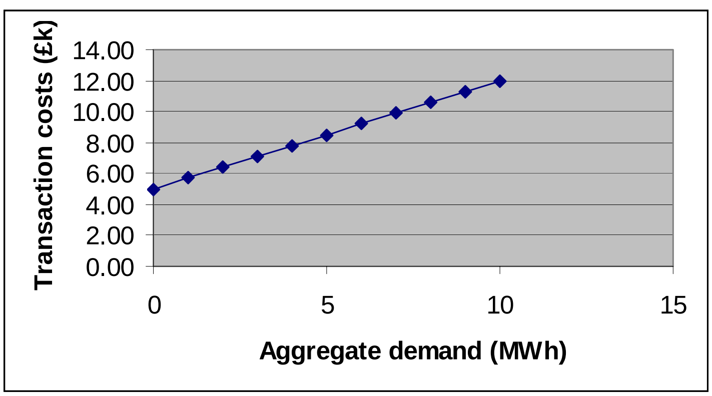


Figure 4.11 shows the resulting saving in total cost, formed by subtracting the transaction costs in Figure 4.10 from the achieved saving in production cost in Figure 4.9. This illustrates a key point: *there is likely to be a lower size threshold below which contracting is no longer viable because transaction costs exceed the saving in production costs*. The extension of contracting to these sites will only be possible if transaction costs can be reduced in some way, or if the sites can be bundled within a multi-site contract. However, evidence from the

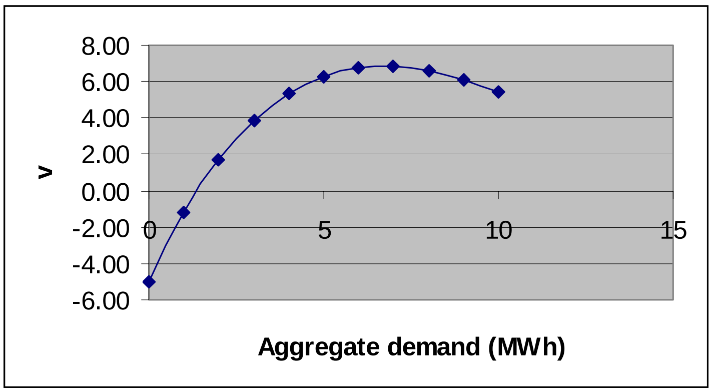
US suggests that attempts to reduce transaction costs through public policy initiatives have been relatively unsuccessful (Rufo, 2001, p. VIII-36). Similarly, multi-site contracts will only be appropriate for those sites that are owned by a larger organisation, such as retail outlets. This suggests that the extension of contracting to SMEs may prove particularly problematic.

The graph also suggests that the achievable cost savings may start to decline once the client exceeds a certain size. Whether this happens in practice will depend upon the relative slope of the above curves. In practice, the total cost savings may simply level off, or continue to increase at a slower rate.

In summary:

- For small clients, contracting may offer large percentage savings in production costs, but the absolute savings are likely to be outweighed by the associated transaction costs. There will be a lower size threshold below which contracting is not viable.
- For large clients, the percentage saving in production costs may be less since contracting may offer fewer advantages compared to in-house energy management. But the absolute saving in production cost may be sufficient to outweigh the associated transaction costs.
- As a result, contracting may potentially be most suitable for 'medium' sized clients. But it all depends upon the relative slope of the curves represented in Figures 4.9 and 4.10.

Figure 4.11 Total cost saving versus aggregate energy demand



4.5.4 Suitability of contracting in different circumstances

The hypotheses in Box 4.1 may be used to provide a stylised indication of the potential suitability of contracting for different types of client (Table 4.7), different types of energy service (Table 4.8) and different market/institutional contexts (Table 4.9). In each table, it is assumed that contracting is more likely when both of the relevant variables act in its favour, and less likely when both act against. In practice, all six variables may need to act in favour of contracting for a particular contract to be viable.

Table 4.7 Suitability of energy service contracting for different types of client

Benchmark production costs for services included in the contract	**Aggregate production cost for the client organisation**		
	Small	**Medium**	**Large**
Small	*	**	*
Medium	***	****	***
Large	****	***	**

Table 4.8 Suitability of energy service contracting for different types of energy service

Asset Specificity	**Task complexity**		
	Low	**Medium**	**High**
Low	*****	****	***
Medium	****	***	***
High	***	**	*

Table 4.9 Suitability of energy service contracting for different types of market/institutional context

Institutional context	**Competitiveness of the energy services market**	
	Low	**High**
Unfavourable	*	**
Favourable	**	***

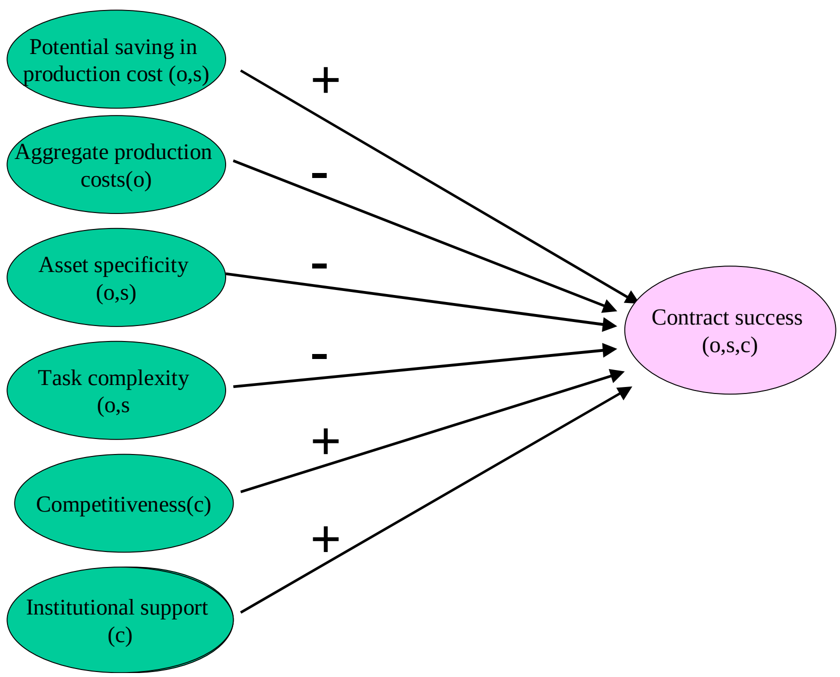
A potential client will need to take all these factors into account by when choosing, *whether* to use energy service contracting, and if so *which* energy services to outsource (contract scope). A contractor will also need to take these into account when marketing its services and bidding for potential contracts. As argued above, energy service contracting is not an either-or decision, but a continuum of options. The minimum requirement for choosing contracting is that the clients' share of the production cost savings are greater than the transaction costs it incurs. The same must apply to the contractor if a contract is to be viable.

4.5.5 Extending the model

The theoretical model may be used above to assess the relative viability of contracting a particular energy service, or to explain the use of contracting for different energy services by different organisations. In an empirical test of the model, a suitable dependent variable would be *whether* a particular organisation has chosen to establish an energy service contract, and if so *which* energy services are included within the contract scope. This is a variant of the 'make or buy' decision, where the combination of production costs and transaction costs are used to explain the choice of governance structure. Consistent with the theory of TCE, the relevant costs are those that are anticipated at the time of making the decision. But contrary to common practice in TCE, production costs are given equal weighting to transaction costs in explaining the choice of organisational arrangements.

In absence of perfect foresight, it is possible that the actual costs of an outsourcing contract will depart from those anticipated. For example, a client may have chosen to use outsourcing for complex tasks and at the same time have failed to instigate adequate monitoring and verification procedures. In this case, the client may suffer from opportunistic behaviour by the contractor and be unsatisfied with the result. This suggests that the same theoretical model could potentially be used to explain the relative *success* of different energy service contracts. An empirical test of this model would investigate whether and to what extent the proposed independent variables explain differences in the measured or perceived success of an energy service contract. The framework is summarised in Figure 4.12.

Figure 4.12 Determinants of contract success



Both these models place great emphasis on the role of opportunism. But as discussed in section 4.4.5, TCE has been criticised for overemphasising opportunism and neglecting the role of trust in into organisational relationships. For example, Poppo and Zenger (2002) explored the role of trust in IT outsourcing and found support for the following propositions:

- Increases in asset specificity and task complexity encourage more <u>complex contracts</u>.
- Increases in asset specificity and task complexity encourage greater <u>trust</u> in the outsourcing relationship.
- Contractual complexity and trust function as <u>complements</u> in explaining the success of an outsourcing contract

In other words, contracts work best when detailed contractual safeguards are combined with the development of trust in the contracting relationship. Contracts that contain both tend to perform better than contracts that just contain one or the other (or neither). Poppo and Zenger suggest that while a good contract may create the environment in which trust can develop, trust can take over from this contract when the limits of detailed contractual specifications are reached. Very similar conclusions are reached in a comparable study by Barthelemy (2003).

These propositions deserve much more detailed consideration than is possible here. In particular, they suggest that further investigation of the complexity of an energy service contract, the degree of trust in the contracting relationship, and the effect of both on contracting success would be highly valuable.

4.5.6 Testing the model

4.5.6.1 Survey design

The hypotheses outlined above require empirical investigation through a structured survey. This requires the development of measures for the relevant dependent and independent variables and the use of regression analysis to identify relationships. Numerous precedents for such a study are available in the literature on information systems outsourcing (Hirschheim, Heinzl *et al.*, 2002).

The viability of a contract depends upon both the size and nature of the client organisation and the choice of energy services to include in the contract (contract scope). Hence, the dependent variable for the model of the contracting decision is *whether* a particular organisation has chosen to establish an energy service contract, and if so *which* energy services are included within the contract scope. For each organisation in the sample, the independent variables need to be measured for the group of services that are outsourced (if any), as well as for the group that are not outsourced.

The hypotheses could potentially be tested through sampling a population of organisations that included some with energy service contracts and some without. In the UK, however, the relative paucity of energy service contracts suggests that a random sample of organisations would be heavily biased towards the latter. Measures taken to ensure an adequate coverage of organisations with energy service contracts may introduce some selection bias.

A more fundamental problem is that the model can only be tested if organisations have evaluated the economics of contracting and ruled it out on the grounds of excessive cost. But in practice, organisations may have failed to consider the option, due to lack of knowledge of the energy service market. A survey could identify the extent to which this is the case in different sectors. But if this is a common reason for neglecting outsourcing, the survey may provide little information on the costs and benefits of outsourcing, since few organisations would have evaluated it. It would therefore be unable to test the model.

A related problem is that organisations may have considered outsourcing, but ruled it out for reasons that are not included in the model, such as business risk or anticipated opposition from staff and unions. A survey could provide valuable information on the relative importance of these factors compared to the narrower cost-benefit calculations considered in the model. These factors could be accommodated through an extension of the model, which could then provide a better explanatory account of the decision to use or not use outsourcing. But if the ‘broader’ reasons are dominant, the survey could again lead to inadequate information being collected on the ‘narrow’ economics of outsourcing, as defined by the ratio of production cost savings to transaction costs.

An alternative approach would be to sample a population of organisations that have established an energy service contract, since these should have conducted an adequate assessment of the costs and benefits. To achieve sufficient variation in the dependent variable, the independent variables could be measured for two groups of energy services: those that are included in the contract, and those that are excluded. The drawback here is that the degree of variation in the independent variables may be relatively restricted. For example, contracting may not be viable for small organisations, but these would be excluded altogether from the sample.

All the above approaches assume that clients have assessed the economics of outsourcing for *all* energy services, including those that are excluded from the contract. In this case, the exclusion of services should have been based upon informed judgement regarding relevant variables such as task complexity on which the client should be able to report. In practice, however, they may have only assessed the economics for a small number of services, such as heat supply and given relatively limited consideration to outsourcing other services. In this case, it would be difficult to obtain adequate measures of the independent variables for the excluded services and therefore be difficult, again, to test the model.

A final alternative is to confine attention solely to those services that have been outsourced and for which the client has made informed judgement. Since such contracts should be viable by definition, there is no longer any variation in the dependent variable for the basic model. However, we could still explore the effect of the independent variables on the *success* of the contract (Figure 4.12). Since some services may be more suitable for outsourcing than others, and since some judgements regarding suitability may be more accurate than others (e.g. some clients may have got it 'wrong'), there should be variation in the dependent variable (success) that is at least partly explainable by the independent variables.

One advantage of this approach is that it is much easier to conduct empirically: the population is confined to clients of energy service companies and to those services that are included in the contracts. A second is that the clients may be expected to have made informed judgements about relevant variables such as task complexity, making them easier to measure. A third is that this survey may be usefully combined with a 'mapping' exercise of the energy service market in a particular sector or country, which may provide some badly needed quantitative data on the size and the nature of the market.

4.5.6.2 UK survey

A survey of this type was attempted during the course of the project for energy service contracts in the UK. The target population was the clients of contractors that were members of ESTA, and the survey was distributed anonymously with the help of the contractors themselves. The survey combined a mapping exercise with a test of the explanatory model. The purpose of the mapping exercise was to identify: the sectors in which clients were located; the scope, depth, method of finance, duration and terms of payment of their contracts; their motivations for signing an energy service contract; and the obstacles they perceived. The purpose of the explanatory survey was to test the hypotheses listed in Box 4.1 regarding the *success* of a contract.

Most of the variables in the model are abstract and multidimensional constructs, so care is needed in developing suitable measures. Table 4.10 lists the measures proposed and used in the UK survey, most of which are based on similar measures used successfully in research on

IT outsourcing. These have performed well in terms of internal consistency and convergent validity in other studies, but there applicability to energy services remains untested.

Unfortunately, several key ESCOs chose not to participate in the survey, leading to a sample population that was both small and very biased. The response rate from participants was also very low (a total of 17 replies), which meant that the sample size was insufficient to derive statistically significant results.

The testing and further development of the models proposed in this section must therefore remain a subject for further research.

Table 4.10 Proposed measures for independent and dependent variables

Variable	**4.5.6.2.1 Proposed measures**
Potential saving in production cost	• *Expected percentage saving in energy costs (%)* • We expected our contract to lead to a significant reduction in our energy costs
Aggregate production costs	• *Annual energy bill (£k)* • We have sufficient expertise in our organisation to perform energy management efficiently in house
Asset specificity	• The contractor has customised its approach to meet the requirements of our organisation • The projects undertaken by the contractor are unique to our sector • The contractor needed to acquire a lot of information about our organisation to perform this contract • It would be time-consuming and costly for us to switch to another contractor • It would be time-consuming and costly for us to take the relevant activities back in-house
Task complexity	• The services provided by the contract are well defined. • It is straightforward to measure the performance of the contractor • It is straightforward to adjust performance measures for factors outside the contractor's control. • It is straightforward to determine the cost savings achieved by the contract. • Monitoring and verification of the contractor’s performance require a great deal of time and effort (reverse coded). • There is a great deal of uncertainty regarding the future demand for these energy services • There is a great deal of uncertainty regarding future needs in terms of technologies for these energy services
Competitivenes s	• There are other companies who could provide us with a comparable service to our present contractor at a competitive price.
Success	• *Percentage saving in energy costs?* Overall level of satisfaction with: • Reducing energy costs • Gaining better control of energy costs • Accessing capital for investment • Transferring risk • Improving the quality and reliability of energy services • Gaining access to up-to-date technology • Gaining access to technical and managerial skills • Replacing ageing equipment • Improving environmental performance • Concentrating attention on the core business

Note:
1 Measures in italics are absolute values
2 Other measures on a 7-point Likert scale (e.g. from very satisfied to very unsatisfied)

4.6 Summary

The existing literature on energy service contracting makes little reference to formal economic theory and does not include formal hypothesis tests. This is surprising given the wealth of economic literature on outsourcing. Based largely upon transaction cost economics (TCE), this work provides an accumulating body of theory and evidence that is highly relevant to the energy service market. This section has taken a number of ideas from the outsourcing literature and used them to improve understanding of the conditions under which an energy service contract is likely to succeed.

The model assumes that the primary motive for contracting is to reduce the total cost of supplying a particular useful energy stream or final energy service, while maintaining adequate standards of service quality and reliability. Total costs may be subdivided into: production costs, which comprise the expenditures for inputs, such as fuel and electricity; and transaction costs, which comprise the costs associated with organising the production of energy services. Energy service contracting offers the potential for reducing production costs compared to the alternative of in-house provision, but at the same time is likely to increase transaction costs. Based on this, the conditions for a successful contract may be stated as:

- the contract payments must be less than or equal to the total savings achieved by the client;
- the contract revenues must be greater than or equal to the total costs incurred by the contractor; and
- the total savings in production cost achieved through the contract must be greater than or equal to the total increase in transaction costs, for the client and contractor combined.

4.6.1 Production costs

There are three reasons why energy service contracts can achieve savings in production costs: a) contractors can provide economies of scale in the provision of energy services; b) competitive tendering can provide energy service contractors with an incentive to minimise bid costs; and c) performance incentives within the contract can provide contractors with an ongoing incentive to minimise costs. But since it should be possible to provide internal energy management staff with comparable performance incentives, the primary advantage of contracting lies in market incentives and economies of scale.

The achieved saving in production costs in a particular contract should depend upon: a) the technical potential for production cost savings for the energy services included within the contract; b) the aggregate production costs for all energy services within the client organisation; c) the specificity of the technologies and skills required to provide the energy services included in the contract; and d) the competitiveness of the energy service market. These variables may be expected to vary widely between different organisations, services and market contexts.

4.6.2 Transaction costs

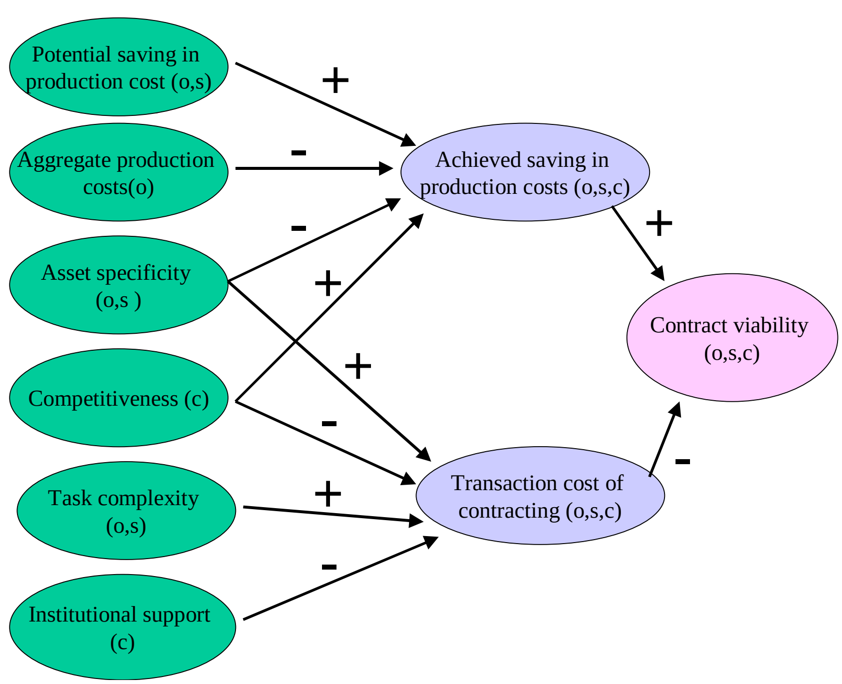
Transaction costs will be associated with the in-house provision of energy services as much as with energy service contracts. But these costs are likely to be higher for the latter, due to the need to identify prospective clients, conduct energy audits, identify potential cost savings, negotiate and write contracts, organise financing, monitor and verify energy cost savings and so on. Evidence from the US suggests that transaction costs routinely form up to 40% of the total costs of a US performance contract, and sometimes as much as 66%. TCE suggests that the magnitude of these costs in a particular instance should depend upon: a) the specificity of the assets required to provide the energy services included within the contract; b) the difficulty in specifying and monitoring contractual terms and conditions (task complexity); c) the competitiveness of the energy service market; and d) the institutional context in which contracting takes place. As with production costs, these variables may be expected to vary widely between different organisations, services and market/institutional contexts.

4.6.3 Theoretical model

Taken together, the above considerations lead to a theoretical model of the economics of energy service contracting, together with seven hypotheses that are suitable for empirical test. This model is reproduced in Figure 4.13. Four of the independent variables are relevant to explaining why particular organisations choose energy service contracting, three are relevant to explaining why particular energy services are included or excluded, and two are relevant to explaining why the take-up of energy service contracts varies between comparable organisations in different contexts (e.g. the US and the UK). The model also suggests that: a) there will be a lower size threshold below which contracting is no longer viable; b) contracting may offer fewer advantages compared to in-house energy management for large clients; and c) contracting may be most suitable for 'medium' sized clients.

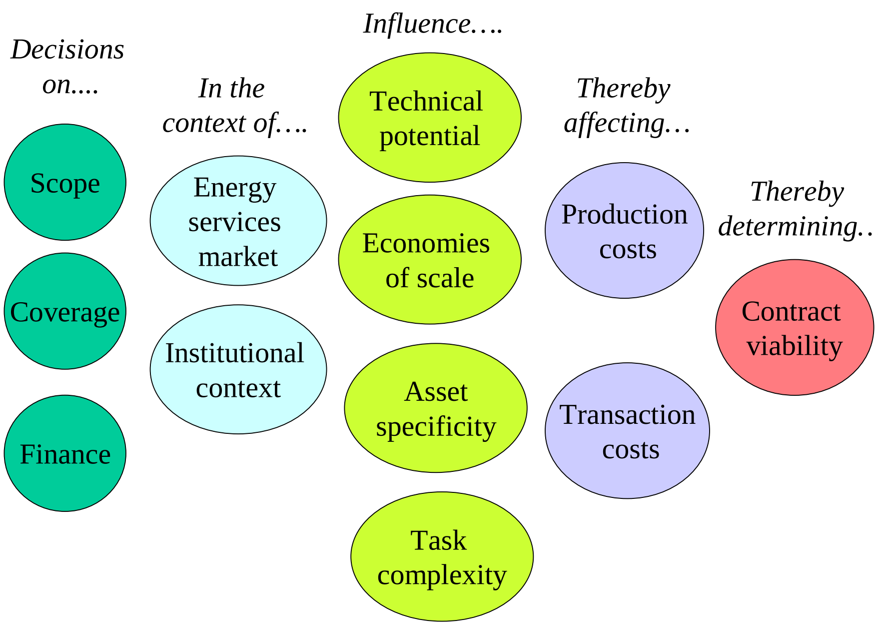
These propositions are very general and require empirical test. This section provides some suggestions on how such tests could be conducted, but an attempt to do so in the UK context unfortunately proved unsuccessful.

Figure 4.13 Summary of the theoretical model



The model an explanatory link between the discussion in Section 2 on the scope, coverage and method of finance of an energy service contract, and the ultimate viability and likely success of that contract. This link is illustrated in stylised form in Figure 4.14.

Figure 4.14 Usual the causal model to link scope, depth and finance to contract viability



5 Conclusion: the contribution of energy service contracting to a low carbon economy

The idea that we are moving from an economy based upon the sale of commodities to one based upon the provision of services has much appeal. By linking environmental concerns to proven business practices such as outsourcing and 'contracting out', the service model appears to offer a promising route to sustainability. Many commentators point to the growth of the 'energy service market' as an exemplar of this approach (James and Hopkinson, 2002). This report has examined this market in detail, focusing upon the economics of energy service contracts. Given the limited data available and the difficulties encountered with the postal survey, the analysis has been largely theoretical and qualitative. Nevertheless, the results suggest that the contribution of energy service contracting to a low carbon economy can easily be overstated. While it clearly has a role to play, this may be smaller than some commentators suggest (Patterson, 1999).

5.1 Nature of the energy service market

The report has highlighted the definitional confusion surrounding the energy services market, the misleading nature of some of the terms used and the need for a commonly agreed terminology. A good example is the use of the term 'guaranteed savings' to refer to contracts where the client takes on debt and 'shared savings' to refer to contracts where the contractor takes on debt. This terminology obscures the fact that guaranteed savings contracts may also involve 'sharing' of savings and that both sharing and guarantees of savings can apply to contracts where neither party takes on debt. More generally, the available literature on energy services is strongly influenced by the US experience and contains ideas and recommendations that may be less appropriate in other contexts.

The report defines energy service contracting as 'the transfer of decision rights over key items of energy equipment under the terms and conditions of a long-term contract, including incentives to maintain and improve equipment performance over time'. This definition suggests that 'payment by results' is the distinguishing feature of an energy service contract, and that other features such as third party financing are neither necessary nor sufficient. The proposed definition is sufficiently broad to encompass a wide range of contracts that are provided by an equally wide range of companies. Nevertheless, the report proposes that all contracts can usefully be classified by their *scope* (what is included), *depth* (how it is included) and the method of *finance*. Contracts may therefore be 'shallow' with a relatively 'narrow' scope, or 'deep' with a relatively 'wide' scope. They may apply to only a single energy service, or may encompass most of the services within a client organisation. Different types of contract may be more or less suitable for different types of client and there should not be a presumption that a 'wider' or 'deeper' contract is always to be preferred. On the contrary, such contracts may only be viable in a limited number of circumstances.

Contrary to common impression, there is no well-defined group of 'energy service companies' (ESCOs) that are distinct from more conventional companies in the energy market. Instead, a range of companies offers energy service contracts (as defined above) under a number of different headings. Most of these companies provide energy service contracts alongside other types of services and in many cases it forms only a small part of their business. Many of the companies providing energy service contracts do not describe themselves as ESCOs, several are not members of the relevant ‘energy service’ trade association (ESTA in the UK) and most are members of several different trade associations. Most companies have evolved from contract maintenance companies or equipment suppliers rather than from energy suppliers, and the use of ‘energy service offerings’ to add value to energy commodity sales tends to be the exception rather than the rule.

The net result of this diversity is that potential clients are confronted with a highly differentiated market, comprising companies selling a variety of non-standard ‘products’ without a commonly agreed system of classification. This contributes to a lack of understanding of what energy service contracts are and what they have to offer. This limited awareness forms a substantial obstacle to the further expansion of the market.

5.2 Economics of the energy service market

The reason energy service companies can provide energy services at lower cost than in-house energy management is that they combine economies of scale with the discipline of market incentives. But at the same time, establishing and monitoring energy service contracts can involve considerable transaction costs. The economics of energy service contracts hinges upon the balance between the two. Excessive transaction costs can undermine the viability of an energy service contract in the same way as they can undermine the viability of energy efficiency investment by the host organisation (Sorrell, Schleich *et al.*, 2004).

An assessment of the market potential for energy service contracting requires a better understanding of the underlying economics than has been achieved to date. Based upon studies of IT outsourcing, this report presents a general framework for understanding the contracting decision and identifies the key determinants of production cost savings and the associated transaction costs. This model suggests that energy service contracting is more (less) likely to be used in situations where:

- the technical potential for production cost savings for the energy services included within the contract are large (small);
- the aggregate production costs for all energy services within the client organisation are small (large);
- the specificity of the assets required to provide the energy services included within the contract are low (high);
- the task complexity, as measured by the difficulty in specifying and monitoring contractual terms and conditions is low (high);
- the market for energy service contracts is more (less) competitive;
- the relevant institutional framework is more (less) conducive to contracting.

These hypotheses need to be tested through survey research. A postal survey was developed for this purpose during the course of the project, but difficulties in obtaining adequate participation from UK ESCOs led to inconclusive results. Testing of this model is therefore a priority for future research. Since there is also lack of basic data regarding the size and structure of the energy service market in Europe, a test of the model could be usefully combined with a ‘mapping’ exercise of the current market.

The theoretical model suggests that contracting may only be appropriate for a subset of energy services within a subset of organisations. Contracting is likely to be particularly unsuitable for final energy services at 'small' sites and process-specific energy services at 'large' sites. More work is required to define these boundaries in quantitative terms and to estimate the proportion of final energy demand that is potentially 'contractable'. Nevertheless, it is clear that a large fraction of final energy use is currently inaccessible to ESCOs and is likely to remain so. Similarly, a large proportion of energy use is accounted for by sites with an annual energy bill of less than £100k/year and which can only be reached if grouped with other sites as part of a multi-site contract. US experience suggests that the extension of contracting to smaller sites is very difficult, even when generous incentives are provided (Rufo, 2001).

While the comprehensive performance contract is often considered as the 'model' for delivering energy services, its range of application may be limited. Despite a 25-year history in the US, comprehensive performance contracts remain largely confined to large public sector clients that lack access to internal financing. These are very complex products that require specialised financing and legal expertise and involve substantial transaction costs. These costs can be offset if the client is relatively large, but larger clients are also better placed to take up energy efficiency opportunities themselves. In many cases, more limited forms of supply contracting may be more appropriate since the transaction costs are less. In other cases, improved energy efficiency may be better encouraged through other policy measures such as voluntary agreements with equipment suppliers, labelling schemes and information programmes. Ultimately, energy service contracting is a means rather than an end and is just one way to deliver improved energy efficiency.

5.3 Climate policy and the energy service market

Policy support for energy service contracting may potentially be justified if substantial market failures affect the contracting market itself. But the existence and importance of such failures is contested: transaction costs clearly inhibit contracting, but to a large extent these are an unavoidable feature of the contracting relationship. They may potentially be reduced through public policy, but only at a cost. There does not seem to be clear evidence that market failures are greater in the contracting market than in many others.

A case can also be made for promoting energy service contracting as a means for overcoming failures in the market for energy efficiency and/or contributing to the reduction of carbon emissions. The relevant market failures here are those that affect the policy ends, rather than one particular means of achieving those ends. In this case, the direct encouragement of contracting can only be justified if the benefits are likely to outweigh the costs and if policy mechanisms targeted more directly on the policy ends are considered to be insufficient. For example, carbon taxation may encourage energy service contracting, as well as energy efficiency investment more broadly. But if political opposition to carbon taxation limits its use, more targeted support for contracting may provide a useful alternative.

Unfortunately, there is little evidence on the costs and benefits of different policy measures for encouraging contracting. Model contracts are widely recommended, but attempts to establish them have been largely unsuccessful in both the US and Europe (Rufo, 2001, ; Ostertag, 2003). Many ESCOs consider their own contracts to be proprietary and doubt the usefulness of model contracts beyond providing a limited foundation for negotiation. This limited interest helps explain the poor quality of the contracts developed in Germany and their subsequent neglect by contractors and clients (Ostertag, 2003, p. 302).

Standardised monitoring and verification schemes are also widely recommended and have led to the development of IPMVP in the US. But both knowledge of and interest in this protocol appears to be minimal within the UK. The assumption behind the IPMVP is that uncertainty over energy savings and the consequent scope for opportunism provides a major obstacle to contracting. But for the supply contracts that dominate in Europe, the level of uncertainty is much less. In practice, uncertainty over energy savings may be secondary to other barriers such as lack of knowledge of contracting opportunities (Ramesohl and Dudda, 2001).

Three other measures to encourage contracting are widely advocated and deserve consideration. The first is to increase information about contracting opportunities, particularly in sectors where the potential appears to be high. The UK has developed a small amount of 'best practice' information in this area, but the impact appears to have been limited.[20] Much more targeted and interventionist approaches been adopted in other countries and regions, including Upper Austria where extensive information and training programmes have been combined with subsidies for individual contracts (~6% of cost). Over the period 1998-2002, this increased the number of ESCOs operating in this region from 2 to 34, and the number of contracts from a handful to over 100 (Egger and Öhlinger, 2003). Expansion of information programmes in the UK should therefore be considered, including a shift from passive dissemination to more active and targeted measures.

The second measure is to develop accreditation schemes for energy service companies that give clients greater confidence in the 'quality' of service provided. As well as reducing the scope for opportunism, accreditation may allow 'high quality' contractors to charge higher prices and thereby recover their additional costs. The voluntary accreditation schemes run by the US and German trade associations (NAESCO and VfW) appear to be successful and a comparable scheme is currently proposed in the Energy Services Directive. The issue here is whether a voluntary scheme is sufficient or whether policy support for establishing the scheme would be beneficial. Such a scheme would be most effective if it were standardised at the European level.

The third and most important measure is to promote energy service contracting through public sector procurement mechanisms such as the PFI. The relatively limited take-up of performance contracting in the UK public sector compared to that in the US suggests a market opportunity. Since the underlying economics should be broadly comparable, the reason for the difference must lie in the incentives for and barriers to contracting within the relevant procurement mechanisms. The PFI process in particular suffers from complicated and time-consuming tendering procedures and high bidding costs that can discourage potential contractors. The state and federal procurement programmes in the US provide useful lessons on how contracting can be encouraged both individually and as part of larger construction projects. Some of these lessons may potentially be applied in the UK.

A combination of the above initiatives and broader-based climate policy measures could undoubtedly increase the market for energy service contracting and increase its contributes to a low carbon economy. But the transaction cost of contracting will continue to provide a

[20] Much has been published on CHP, but little on performance contracting or on energy service contracting more generally.

substantial obstacle and many energy services will remain inaccessible to the contracting approach. Energy service contracts are likely to continue to be offered by engineering firms rather than energy supply companies, and a wholesale shift from commodity to service supply appears very unlikely. In short, while energy service contracting may have an important role to play, it can only form part of a broader strategy for achieving a low carbon economy.

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